8020B
Digital Multimeter

Instruction Manual

FLUKE®

NOTE

This manual documents the Model 8020B and its assemblies at the revision levels shown in Appendix A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or the backdating sheet in Appendix A for older assemblies.

8020B
Digital Multimeter

Instruction Manual

P/N 616029
JULY 1981
Rev.1 7/82
©1981, John Fluke Mfg. Co., Inc.,
all rights reserved Litho in U.S.A.

FLUKE®

Dear Customer:

Congratulations! We at Fluke are proud to present you with the Model 8020B Multimeter. This instrument represents the very latest in integrated circuit and display technology. As a result, the end product is a rugged and reliable instrument whose performance and design exhibit the qualities of a finely engineered lab instrument.

To fully appreciate and protect your investment, we suggest you take a few moments to read the manual. As always, Fluke stands behind your 8020B with a full 2 year warranty and a worldwide service organization. If the need arises, please don't hesitate to call on us.

Thank you for your trust and confidence.

John Fluke Mfg. Co., Inc.

Table of Contents

SECTION	TITLE	PAGE
1	**INTRODUCTION AND SPECIFICATIONS**	1-1
	1-1. INTRODUCTION	1-1
	1-3. PREPARING FOR OPERATION	1-2
	1-4. Unpacking	1-2
	1-7. Battery and/or Fuse Installation/Replacement	1-2
	1-9. PHYSICAL FEATURES	1-4
	1-11. INITIAL CHECK-OUT PROCEDURE	1-4
	1-13. ACCESSORIES	1-9
	1-15. SPECIFICATIONS	1-9
2	**OPERATING INSTRUCTIONS**	2-1
	2-1. INTRODUCTION	2-1
	2-3. INPUT POWER	2-1
	2-4. Battery Life	2-1
	2-6. Line Power Operation	2-1
	2-8. OPERATING NOTES	2-1
	2-10. Input Overload Protection	2-2
	2-12. Input Connections to COMMON	2-3
	2-14. Fuse Check	2-3
	2-16. Fuse Replacement	2-3
	2-18. The Display	2-3
	2-22. OPERATION	2-4
	2-24. MEASUREMENT TECHNIQUES	2-10
	2-26. AC Measurement	2-10
	2-28. Voltage AC/DC	2-10
	2-31. Current AC/DC	2-10
	2-35. Resistance	2-14
	2-39. Continuity	2-19
	2-42. Conductance	2-15
	2-46. APPLICATIONS	2-15
	2-48. Transistor Tester	2-17
	2-53. Leakage Tester	2-19

(continued on page ii)

TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
3	**THEORY OF OPERATION**	**3-1**
	3-1. INTRODUCTION	3-1
	3-3. OVERALL FUNCTIONAL DESCRIPTION	3-1
	3-8. BLOCK DIAGRAM ANALYSIS	3-1
	3-9. A/D Converter	3-1
	3-18. Input Signal Conditioners	3-6
4	**MAINTENANCE**	**4-1**
	4-1. INTRODUCTION	4-1
	4-3. SERVICE INFORMATION	4-1
	4-7. GENERAL INFORMATION	4-2
	4-8. Access Information	4-2
	4-17. Cleaning	4-5
	4-19. Battery/Backup Fuse Replacement	4-5
	4-21. PERFORMANCE TEST	4-6
	4-23. Initial Procedure	4-6
	4-25. Display Test	4-6
	4-27. Resistance Test	4-7
	4-29. Continuity Test	4-7
	4-31. DC Voltage Test	4-8
	4-33. AC Voltage Test	4-8
	4-35. DC Current Test	4-9
	4-37. CALIBRATION	4-10
	4-40. TROUBLESHOOTING	4-11
5	**LIST OF REPLACEABLE PARTS**	**5-1**
	5-1. INTRODUCTION	5-1
	5-4. HOW TO OBTAIN PARTS	5-1
6	**ACCESSORY INFORMATION**	**6-1**
	6-1. INTRODUCTION	6-1
	6-3. DELUXE CARRYING CASE (C-90)	6-1
	6-5. TEMPERATURE PROBE (80T-150C and 80T-150F)	6-1
	6-6. Introduction	6-1
	6-8. Specifications	6-1
	6-9. CURRENT TRANSFORMER (801-600)	6-4
	6-10. Introduction	6-4
	6-12. Specifications	6-4
	6-13. HIGH VOLTAGE PROBE (80K-6)	6-4
	6-14. Introduction	6-4
	6-16. Specifications	6-4
	6-17. HIGH VOLTAGE PROBE (80K-40)	6-4
	6-18. Introduction	6-4
	6-20. Specifications	6-5
	6-21. HIGH FREQUENCY PROBE (83RF)	6-5

(continued on page iii)

TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
	6-22. Introduction	6-5
	6-24. Specifications	6-5
	6-25. HIGH FREQUENCY PROBE (85RF)	6-5
	6-26. Introduction	6-5
	6-28. Specifications	6-5
	6-29. BATTERY ELIMINATOR (A81-115)	6-6
	6-31. CURRENT SHUNT (80J-10)	6-6
	6-32. Introduction	6-6
	6-34. Specifications	6-7
	6-35. AC/DC CURRENT PROBE (Y8100)	6-7
	6-36. Introduction	6-7
	6-39. Specifications	6-7
	6-40. AC CURRENT TRANSFORMER (Y8101)	6-8
	6-41 Introduction	6-8
	6-42. Specifications	6-8
	6-44. SAFETY DESIGNED TEST LEAD SET (Y8132)	6-8
	6-46. DELUXE TEST LEAD SET (Y8134)	6-8
	6-48. SLIM FLEX TEST LEAD SET (Y8140)	6-8
7	**SCHEMATIC DIAGRAMS**	7-1
	APPENDIX A	A-1

List of Tables

TABLE	TITLE	PAGE
1-1.	8020B Controls, Indicators and Connectors	1-6
1-2.	8020B Accessories	1-9
1-3.	Specifications	1-9
2-1.	Input Overload Limits	2-2
2-2.	Voltage/Current Capability of Resistance Ranges	2-14
4-1.	List of Recommended Test Equipment	4-2
4-2.	Resistance Checks	4-7.
4-3.	DC Voltage Checks	4-8.
4-4.	AC Voltage Test	4-9.
4-5.	DC Current (mA) Checks	4-10
4-6.	Troubleshooting Guide	4-11
5-1.	8020B Final Assembly	5-3.
5-2.	A1 Main PCB Assembly	5-6.
5-3.	A2 Annunciator PCB Assembly	5-10
5-4.	Federal Supply Codes for Manufacturers	5-10
6-1.	A81 Model Numbers for Various Input Power Configurations	6-6

List of Illustrations

FIGURE	TITLE	PAGE
1-1.	Removing the Battery Cover	1-3
1-2.	Battery Removal	1-4
1-3.	Controls, Indicators and Connectors	1-5
2-1.	Volts Operation	2-5
2-2.	Currents Operation	2-6
2-3.	Resistance Operation	2-7
2-4.	Conductance Operation	2-8
2-5.	Continuity Operation	2-9
2-6.	Waveform Conversion	2-11
2-7.	Voltage Measurement Error Calculations	2-12
2-8.	Current Measurement Error Calculations	2-13
2-9.	Conductance-to-Resistance Conversion	2-16
2-10.	Transistor Beta Test Fixture	2-18
3-1.	Model 8020B Simplified Block Diagram	3-3
3-2.	Dual Slope A/D Converter	3-4
3-3.	Input Signal Conditioners	3-8
4-1.	Calibration Adjustment Locations	4-3
4-2.	LCD Display Assembly	4-4
5-1.	8020B Final Assembly	5-5
5-2.	A1 Main PCB Assembly	5-9
5-3.	A2 Annunciator PCB Assembly	5-11
6-1.	Model 8020B Accessories	6-2

Section 1
Introduction and Specifications

1-1. INTRODUCTION

1-2. Your John Fluke Model 8020B is a pocket-size digital multimeter that is ideally suited for application in the field, lab, shop or home. Some of the features of your instrument are:

- All VOM functions plus conductance and continuity (8 in all) are included as standard.

  DC Voltage - 100 μV to 1000V
  AC Voltage - 100 μV to 750V
  DC Current - 1 μA to 2000 mA
  AC Current - 1 μA to 2000 mA
  Resistance - 0.1Ω - 20 MΩ
  Diode Test
  Conductance - 0.1 ns to 200 ns and .001 ms to 2 ms (S = siemens = 1/Ω).
  Continuity - Provides an immediate audible indication when continuity is detected.

- CONDUCTANCE - A new multimeter function that allows fast, accurate, noise free resistance measurements up to 10,000 MΩ.

- A high contrast 3-1/2 digit liquid crystal display that can be easily read from across the room. No more worries about bent needles, parallax, etc.

- Each range has:

  Full auto-polarity operation
  Overrange indication
  Effective protection from overloads

- Dual slope integration measurement technique to ensure noise-free measurements.

- Long term calibration stability - 2 years. Easy calibration - few adjustments.

- Lightweight - 369 grams (13 ounces).

- Up to 200 hours of continuous operation can be expected from a single, inexpensive, 9V, alkaline battery (transistor radio/calculator type).

- Low battery voltage automatically detected and displayed.

- Line operation is possible using a Model A81 Battery Eliminator (see Section 6, Accessories).

- Protected test leads - finger guards on the probes and shrouded contacts on the connectors discourage accidental contact with circuit voltages.

- A full line of accessories that extend the range and scope of your instrument.

1-3. PREPARING FOR OPERATION

1-4. Unpacking

1-5. Your 8020B was packed and shipped in an especially designed protective container. This manual, the multimeter, one 9V battery, and two test leads (one red and one black) should be packed in the shipping container. Check your shipment thoroughly. If anything is wrong with your shipment, contact the place of purchase immediately. If satisfaction is not obtained, contact the nearest John Fluke Service Center. A list of these service centers is located at the end of this manual.

1-6. If reshipment is necessary, please use the original shipping container. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please state the instrument model number when requesting a new shipping container.

1-7. Battery and/or Fuse Installation/Replacement

1-8. Your 8020B is designed to operate on a single, inexpensive, 9V battery of the transistor radio/calculator variety (NEDA 1604). When you receive your 8020B the battery will not be installed in the DMM. Once the battery is installed, you can expect a typical operating life of up to 200 hours with an alkaline battery or 100 hours with a carbon-zinc battery. When the battery has exhausted about 80% of its useful life, the BT indicator will appear in the upper left corner of the display. Your 8020B will operate properly for at least 20 hours after BT appears. Use the following procedure to install or replace the battery and to replace the fuse.

WARNING

TO AVOID ELECTRICAL SHOCK HAZARDS REMOVE THE INPUT SIGNAL AND THE TEST LEADS FROM THE INPUT TERMINALS, AND SET THE POWER SWITCH TO OFF BEFORE OPENING THE BATTERY COMPARTMENT.

1. Set the 8020B power switch to OFF.

2. Remove the test leads from external circuit connections and from the 8020B input terminals.

3. Open the battery compartment on the bottom of the 8020B using the method shown in Figure 1-1.

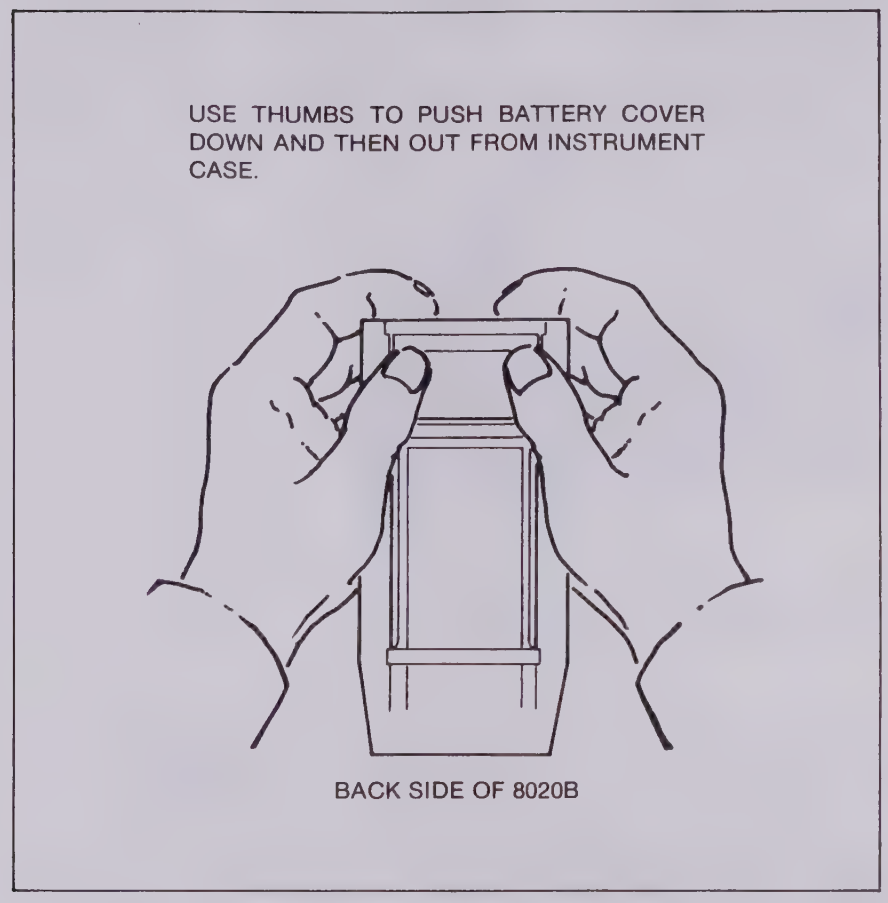


Figure 1-1. Removing the Battery Cover

4. Tilt the battery out as shown in Figure 1-2.

5. If fuse F1 is to be replaced, use a pointed tool such as a probe tip or small screwdriver to pry F1 from its holder. Replace the defective fuse with fuse type AGX2. (Instruments that accommodate metric fuses use type F.)

6. Disconnect the battery clip from the battery.

7. Press the battery clip onto the replacement battery and return both to the battery compartment.

8. Make sure the battery leads are routed by the broad side of the battery and fully within the confines of the battery compartment before sliding the cover into place.

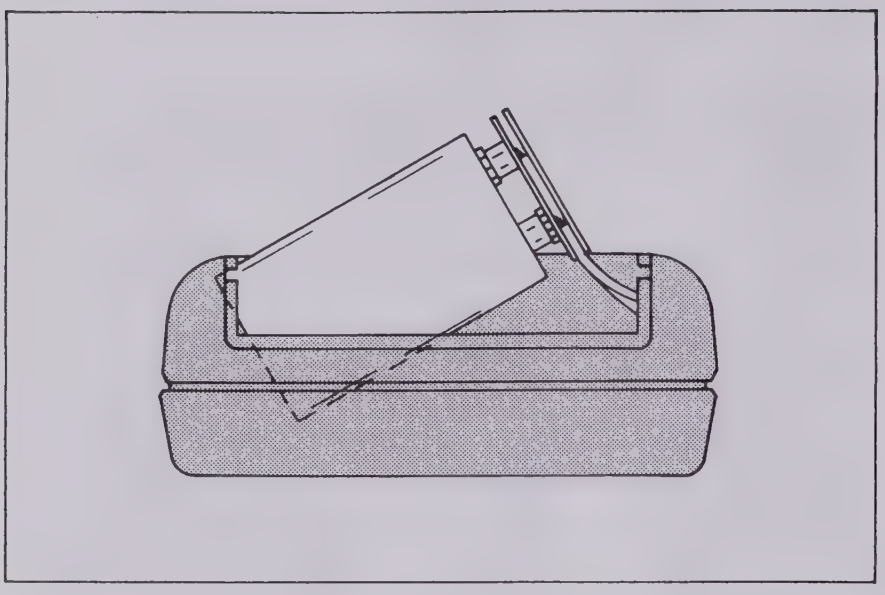


Figure 1-2. Battery Removal

WARNING

DO NOT OPERATE THE 8020B UNTIL THE BATTERY COVER IS IN PLACE AND FULLY CLOSED.

1-9. PHYSICAL FEATURES

1-10. Before using your 8020B we suggest that you take a few minutes to get acquainted with your instrument. All of the externally accessible physical features of the 8020B are shown in Figure 1-3 and described in Table 1-1. Locate each feature on your 8020B as you read the description.

1-11. INITIAL CHECK-OUT PROCEDURE

1-12. Now that you have installed the battery, and know where everything is, let's make sure the unit is working properly. We'll run through a simple check-out procedure, starting with turn-on. No equipment other than the test leads will be required. If a problem is encountered, please recheck the battery, fuses, switch settings, and test lead connections before contacting your nearest authorized John Fluke Service Center.

NOTE

This procedure is intended to verify overall instrument operation, and is not meant as a substitute for the formal Performance Test given in Section 4. Limits shown exceed the specifications because the procedure uses one measurement to check another.

1. Set the power switch to OFF and all range and function switches to the released (out) position.

2. Set the power switch to ON and observe the display. It should read 00.0 ±0.1.

3. Connect the red test lead to the V/Ω input terminal.

4. Touch the red probe tip to the COMMON input terminal, and sequentially depress each of the six range switches starting at the top (20 MΩ). The display should read zero ±one digit and the decimal point should be positioned as follows:

a. 20M - 0.00
b. 2000k - 000
c. 200k - 00.0
d. 20k - 0.00
e. 2k - .000
f. 200 - 00.0

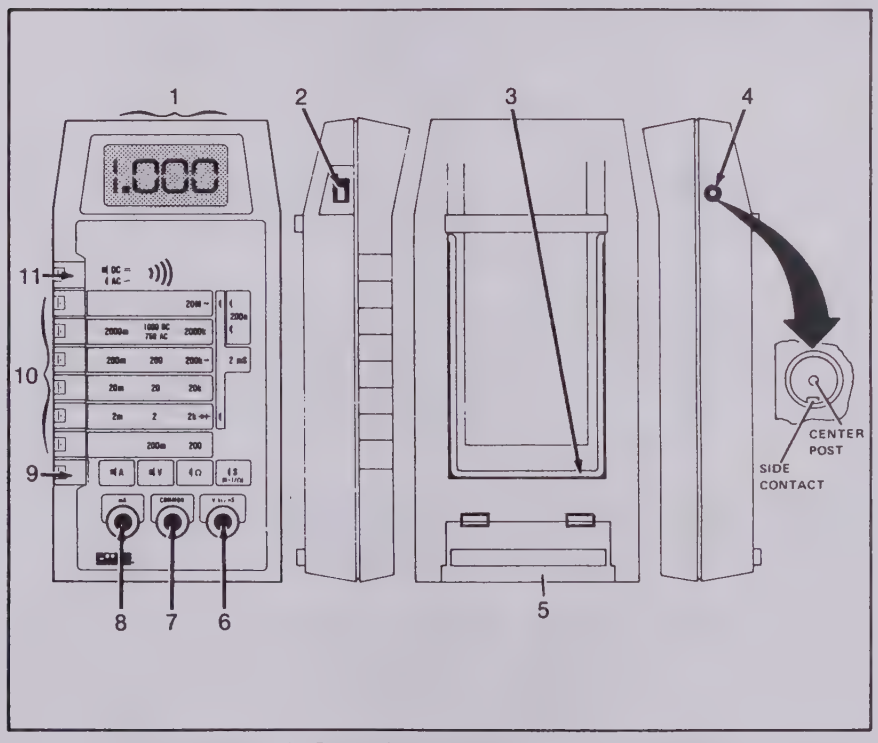


Figure 1-3. Controls, Indicators and Connectors

Table 1-1. 8020B Controls, Indicators and Connectors

ITEM NO.	NAME	FUNCTION
1	Display	A 3-1/2 digit display (1999 max, with decimal point and minus polarity indication, used to indicate measuremet values, overrange conditions, and a low battery condition.
2	Power Switch	A slide switch used to turn the instrument off and on.
3	Tilt Bail	A removable fold-out stand which allows the instrument to be either tilted for bench-top applications or hung from a hook in the absence of a work surface.
4	Battery Eliminator and Connector	An external input power connector for use with the Model A81 Battery Eliminator accessory. (A81 is available in a variety of voltage and plug configurations. See Section 6.)
5	Battery Compartment and Cover	Cover for the 9V battery and the current-protection fuse. Refer to figure 1-1 for battery cover removal instructions.
6	V/Ω/S Input Connector	Protected test lead connector used as the high input for all voltage, resistance, continuity and conductance measurements. Will accept banana plugs.
7	COMMON Input Connector	Protected test lead used as the low or common input for all measurements. Will accept banana plugs.
8	mA Input Connector	Protected test lead connector used as the high input for all current measurements. Will accept banana plugs.

Table 1-1. 8020B Controls, Indicators and Connectors (cont)

ITEM NO.	NAME	FUNCTION
9	mA/V-Ω/S Switch	A push-push switch (push on - push off, do not pull to select function) which is operated in conjunction with the high input connectors to select either the mA/V or Ω (conductance) measurement functions. When the switch is in or depressed Ω is selected. The mA or V function is selected in the out position depending upon the location of the high input lead.
10	Range Switches	Interlocked push-button switches for selecting ranges; i.e., press the desired range switch to select that range and cancel previous switch depressions. Do not pull the switches to select a range. Voltage: 200 mV, 2v, 20V, 200V, 1000V dc/750V ac Current: 2 mA, 20 mA, 200 mA, 2000 mA Resistance: 200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ Conductance: 100 nS or 2 mS (S = siemens = 1/Ω = international unit of conductance). Conductance requires simultaneous depression of two range switches.
11	DC/AC/ ı))) Switch	A push-push switch (push on - push off, do not pull to select function) used to select the ac or dc measurement function when measuring current or voltage. When in, or depressed, the ac function is selected. Output selects dc. When used with the Ω or S functions, the in position enables the audible continuity tone.

5. Press the 20V range switch and remove the probe from the COMMON input terminal.

6. Look inside of the battery eliminator connector on the right side of the 8020B and locate the connector contacts (center post and side contact as shown in Figure 1-3).

7. Touch the red probe tip to the center post of the battery eliminator connector. The display should read approximately –6.1V dc.

8. Touch the probe tip to the side contact of the battery eliminator connector. The display should read approximately 2.9V dc. Notice that the sum of the two readings is equal to the battery voltage (typically 8 to 10V dc). Remove the probe from the battery jack.

9. Depress the lower function button (Ω) and sequentially depress each of the six range switches. The display should read 1 as the most significant digit with no other numbers shown. This is the standard overrange indication. Notice that the decimal point changes position with the range switch settings just as it did in step 4 of this procedure.

10. Touch the red probe tip to the COMMON input terminal, and sequentially press each of the range buttons. The display should read zero at each range setting. Lead resistance may be sufficient to cause a one or two tenths (0.1 or 0.2Ω) indication on the 200Ω range.

11. Touch the red probe tip to the mA input connector and press the 200Ω switch. The display should read 99.0 to 101.0.

12. Press the 2 kΩ switch. The display should read .099 to .101. Remove the probe from the mA input connector.

13. Simultaneously depress the 2000 kΩ and the 20 MΩ range switches. This selects the 200 nS range. The display should read 00.0 to 01.0 (minimum conductance, maximum resistance).

14. Touch the red probe tip to the COMMON input connector. An overrange indication should be displayed since conductance is the reciprocal of resistance.

15. Connect the black test lead to the COMMON input connector.

16. Depress both AC/DC switch and the 750V ac range switch. Set the mA/V-Ω switch to the voltage (out) position.

WARNING

THE LOCAL LINE VOLTAGE IS MEASURED IN THE FOLLOWING STEP. BE CAREFUL NOT TO TOUCH THE PROBE TIPS WITH YOUR FINGERS, OR TO ALLOW THE PROBE TIPS TO CONTACT EACH OTHER.

17. Measure the local ac line voltage at a convenient output receptacle. The voltage should be displayed with 1 volt resolution.

18. If the 8020B has responded properly to this point, it is operational and ready for use.

1-13. ACCESSORIES

1-14. Table 1-2 lists the accessories available for use with the Model 8020B. Detailed information about each accessory is provided in Section 6.

1-15. SPECIFICATIONS

1-16. Table 1-3 lists the 8020B specifications. These specifications assume a 2 year calibration cycle and an operating temperature of 18°C to 28°C (64°F to 82°F) at a relative humidity of up to 90% unless otherwise noted.

Table 1-2. 8020B Accessories

ACCESSORY	DESCRIPTION
A81	Battery Eliminator
C-90	Vinyl Carrying Case
80T-150C	Temperature Probe °C
80T-150F	Temperature Probe °F
80I-600	Current Transformer 2" jaws
80K-6	High Voltage Probe
80K-40	High Voltage Probe
80J-10	Current Shunt
83RF	High Frequency Probe
85RF	High Frequency Probe
Y8100	AC/DC Current Probe
Y8101	Current Transformer 7/16" jaws
Y8132	Safety Designed Test Lead Set
Y8134	Deluxe Test Lead Set
Y8140	Slim Flex Test Lead Set

Table 1-3. 8020B Specifications

The following specifications assume a 2-year calibration cycle and an operating temperature of 18°C to 28°C (64°F to 82°F) at a relative humidity up to 90%, unless otherwise noted.

FUNCTIONS ..... DC Volts, AC Volts, DC Current, AC Current, Resistance, Conductance, and Continuity.

Table 1-3. 8020B Specifications (cont)

DC VOLTS

RANGE	RESOLUTION	ACCURACY FOR 2 YEARS
±200 mV	100 μV	±(0.1% of reading +1 digit)
±2V	1 mV	
±20V	10 mV	
±200V	100 mV	
±1000V	1V	

Overvoltage Protection ..... 1000V dc or peak ac on all ranges.
Input Impedance ..... 10 MΩ, all ranges.
Normal Mode Rejection Ratio >60 dB at 50 Hz and 60 Hz.
Common Mode Rejection Ratio (1 kΩ unbalance) ..... >100 dB at dc, 50 Hz and 60 Hz.
Response Time ..... Less than one second.

AC VOLTS (Average Sensing, RMS Calibrated For Sinewave)

RANGE	RESOLUTION	ACCURACY		
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz
200 mV	100 μV	±(0.75% of reading +2 digits)	±(1.5% of reading +3 digits)	±(5% of reading +5 digits)
2V	1 mV			
20V	10 mV			
200V	0.1V			Not specified
750V	1V	±1% of reading +2 digits	Not specified	

Overload Protection ..... 750V rms or 1000V peak continuous, except 200 mV ac ranges (15 seconds maximum above 300V rms ac).
Common Mode Rejection Ratio (1 kΩ unbalance) ..... >60 dB at 50 Hz and 60 Hz.
Volt-Hz Product ..... 10^7 max (200V @ 50 kHz).
Input Impedance ..... 10 MΩ in parallel with <100 pF.

DC CURRENT

RANGE	RESOLUTION	ACCURACY FOR 2 YEARS	BURDEN VOLTAGE
2 mA	1 μA	±(0.75% of reading +1 digit)	0.3V max
20 mA	10 μA		
200 mA	100 μA		
2000 mA	1 mA		0.9V max

Overload Protection ..... 2A/250V fuse, in series with a 3A/600V fuse.

Table 1-3. 8020B Specifications (cont)

AC CURRENT

RANGE	RESOLUTION	ACCURACY FOR 2 YEARS		BURDEN VOLTAGE
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 μA	±(3% rdg +2 d)	Not Specified	0.3V rms max
20 mA	10 μA	±(1.5% of reading +2 digits)		
200 mA	100 μA			
2000 mA	1 mA			0.9V rms max

Overload Protection ..... 2A/250V fuse, in series with a 3A/600V fuse.

RESISTANCE

RANGE	RESOLUTION	ACCURACY FOR 2 YEARS	FULL-SCALE VOLTAGE	MAXIMUM TEST CURRENT
200Ω	0.1Ω	±(0.2% of reading +3 digits)	<0.25V	.35 mA
2 kΩ→|	1Ω	±(0.1% of reading +1 digit)	>1.0V	1.1 mA
20 kΩ	10Ω		<0.25V	13 μA
200 kΩ	100Ω		>0.7V	13 μA
2000 kΩ	1 kΩ	±(2% of reading +1 digit)	<0.25V	0.13 μA
20 MΩ	10 kΩ		>.7V	0.13 μA

Overload Protection ..... 500V dc rms ac on all ranges. 15 seconds maximum above 300 volts.

Open Circuit Voltage ..... Less than 1.5V on all ranges except 2 kΩ range is less than 3.5V.

Diode Test (Hi-Lo Ohms) ... 2 kΩ, 200 kΩ, and 20 MΩ ranges supply enough voltage to turn on junctions allowing a "Diode Test". The 2 kΩ range is preferred and is marked with a diode symbol. 200Ω, 20 kΩ, and 2000 kΩ ranges can make in-circuit measurements without turning on silicon junctions.

CONDUCTANCE

RANGE	ACCURACY
2 mS	±(0.2% of reading +1 digit)
200 nS	±(2.0% of reading +10 digits)

Overload Protection ..... 500V dc/rms ac on all ranges.

Open Circuit Voltage ..... 2 mS <3.5V
200 nS <1.5V

Diode Test ..... Both ranges will forward bias a typical PN junction.

Table 1-3. 8020B Specifications (cont)

CONTINUITY (for Passive Circuit Testing)*	
Ranges	All resistance ranges. (2 kΩ range recommeded for lowest resistance threshold)
Indication	
CONTINUITY	Audible tone
OPEN CIRCUIT	No audible tone
Response Time	50 μs (Minimum duration of continuity or open to toggle audible tone) on 2 kΩ range. Pulse stretcher holds tone on or off for approximately 200 ms.
Overload Protection	500V dc/rms ac on all ranges.
GENERAL	
Protection Class 2	Relates solely to insulation or grounding properties defined in IEC 348.
Maximum Common Mode Voltage	500V dc/rms ac.
Power Requirements	Single 9V battery, NEDA 1604.
BATTERY LIFE	
Alkaline	200 hours typical.
Zinc Carbon	100 hours typical.
BATTERY INDICATOR	"BT" on display illuminates when approximately 20% of battery life remains.
Display	3½ digit LCD (2,000 count), autozero, autopolarity.
Size	L x W x H: 18.0 cm x 8.6 cm x 4.5 cm (7.1 in x 3.4 in x 1.8 in)
Weight	0.37 kg. (13 oz)
ENVIRONMENTAL	
Temperature	0°C to 50°C (32°F to 122°F) operating. -35°C to +60°C (-31°F to 140°F) storage.
Relative Humidity	0 to 80%, 0°C to 35°C (32-95°F) on 2 MΩ, 20 MΩ, and 200 nS ranges. 0-90%, 0°C to 35°C (32-95°F) on all other ranges. 0 to 70%, 35°C to 50°C (95-122°F)
Temperature Coefficient	<0.1 times the applicable accuracy specification per °C for 0°C to 18°C and 28°C to 50°C (32°F to 64.4°F and 50.4°F to 122°F).

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. To fully utilize the measurement capabilities of your 8020B, a basic understanding of its measurement techniques and limitations is required. This section of the manual provides that information, plus a few applications that may prove useful. For example, did you know your 8020B will provide direct-reading dc current gain (beta) measurements for both NPN and PNP transistors? Read this section of the manual to find out how it's done.

2-3. INPUT POWER

2-4. Battery Life

2-5. The 8020B is designed to operate on an single, inexpensive 9V battery of the transistor radio/calulator variety (NEDA 1604). If an alkaline battery is used, a typical operating life of up to 200 hours can be expected. Carbon-zinc batteries will have a useful life of up to 100 hours. In either event, the 8020B will display a BT (in upper, left-hand corner) when the battery has exhausted approximately 80% of its useful life. When BT first appears, the battery is capable of properly operating the 8020B for at least another 20 hours.

CAUTION

To ensure multimeter operation within the accuracy specifications, the battery should be replaced when the voltage measured at the center of the battery eliminator connector falls below -3.00 volts (with respect to the COMMON input). If the battery voltage falls to a point where the "BT" is displayed and the digital display is inactive or no longer responds to an input signal, the battery should be replaced immediately to prevent damage to the LCD.

2-6. Line Power Operation

2-7. You can operate your 8020B from line power by using the A81 Battery Eliminator Accessory. Refer to Section 6 for additional information about the A81.

2-8. OPERATING NOTES

2-9. The following paragraphs will familiarize you with the capabilities and limitations of your Model 8020B and instruct you in routine operator maintenance.

2-10. Input Overload Protection

CAUTION

Exceeding the maximum input overload limits can damage your instrument. A transient overload protection circuit is designed into the 8020B to protect it against short duration high energy pulses. The components used limit the protection to approximatly five pulses per second for 6 KV, 10 microsecond pulses, and about 0.6 watts average for lower amplitude pulses. Fast repetition rate pulses, such as those from a TV set, can damage the protection components; RJ1 - RJ4, R1 and R2. If any of these components require replacement, use only Fluke parts to ensure product safety. (R2 is a special flameproof fusible resistor. Use exact replacement to ensure safety.)

2-11. Each measurement function and its associated ranges are equipped with input overload protection. The overload limits for each function and range are given in Table 2-1.

Table 2-1. Input Overload Limits

SELECTED FUNCTION	SELECTED RANGE	INPUT CONNECTIONS	MAX. INPUT OVERLOAD
Voltage	200 mV, 2V, 20V, 200V, 750V ac, 1000V dc	V/kΩ and COMMON	1000V dc or peak ac on dc ranges. 1000V dc or 750V rms on ac range-15 seconds max. on 200 mV ac range.
Current	2 mA, 20 mA, 200 mA, 2000 mA	mA and COMMON	2A max. Fuse protected in circuits with open circuit voltage ≤250V dc/rms ac. Do not use above 250V.
Resistance Conductance, or Continuity	200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ, 200 nS, 2 mS	V/Ω and COMMON	500V dc or rms ac. 15 seconds maximum above 300 volts.
ANY	ANY	COMMON	500V dc/rms ac with respect to earth ground.

2-12. Input Connections to COMMON

WARNING

TO AVOID ELECTRICAL SHOCK AND /OR INSTRUMENT DAMAGE DO NOT CONNECT THE COMMON INPUT TERMINAL TO ANY SOURCE OF MORE THAN 500 VOLTS DC OR RMS AC ABOVE EARTH GROUND.

2-13. The 8020B may be operated with the COMMON input terminal at a potential of up to 500V dc or 500V rms ac above earth ground. If this limit is exceeded, instrument damage may occur. This, in turn, may result in a safety hazard for the operator.

2-14. Fuse Check

2-15. The current (mA) function contains two fuses. Check them as follows:

1. Complete the set up steps for the RESISTANCE (Ω) function and select the 2 kΩ range.

2. Touch the red test probe to the mA input jack so that the V-Ω input and mA input are connected together.

3. If the display reads approximately .100 kΩ, both fuses are good.

4. If the display reads overrange, 1 followed by blank digits, one or both fuses need replacement. See the following paragraph for replacement instructions.

2-16. Fuse Replacement

2-17. All ac and dc current ranges are fuse protected. Two series fuses are used:

1. F1, 2A@ 250V, replaceable at the battery compartment (see section 1 "Battery or Fuse Installation/Replacement")

2. F2, 3A@ 600V backup fuse (see section 4, Battery/Backup Fuse Replacement).

2-18. The Display

2-19. The Front Panel Display on your 8020B is a 3-1/2 digit Liquid Crystal Display. The 1/2 digit is the extreme left digit location. So, the displayed value can range from 000 through 1999. For convenience, in discussion, the 1999 is rounded to 2000. The decimal point position is determined by selected range and is not affected by the measurement function selected. Polarity, on the other hand is only used for the dc voltage and current measurement functions. A minus sign indicates that the input signal is negative with respect to the COMMON input terminal. Positive inputs are indicated by the absence of the minus sign.

NOTE

The minus sign (-) may flash momentarily as the 8020B comes out of an overrange condition. This will most likely be seen in the ohms mode as the open circuit test leads are applied to an in-range resistance value. If the minus sign remains on for in-range ohms readings, the circuit is live (a negative voltage is present at the input terminals due to charged capacitors, etc.), and incorrect resistance readings will be observed.

2-20. The Display has two abnormal status indicators, one for low battery power and one for instrument overrange. a "BT" is displayed when approximately 80% of the battery's life is exhausted (battery replacement is indicated). And, a "1" followed by three blanked digits is displayed (decimal point may be present) as an overrange indication. This does not necessarily mean that the instrument is being exposed to a damaging input condition. For example, when measuring resistance an open-input will cause an overrange indication.

NOTE

When the 8020B is powered with the A81 Battery Eliminator the "BT" indicator may come on. However, instrument operation will be normal.

2-21. The liquid crystal display used in the 8020B is a rugged and reliable unit which will give years of satisfactory service. Display life can be extended by observing the following practices:

1. Protect the display from extended exposure to bright sunlight.

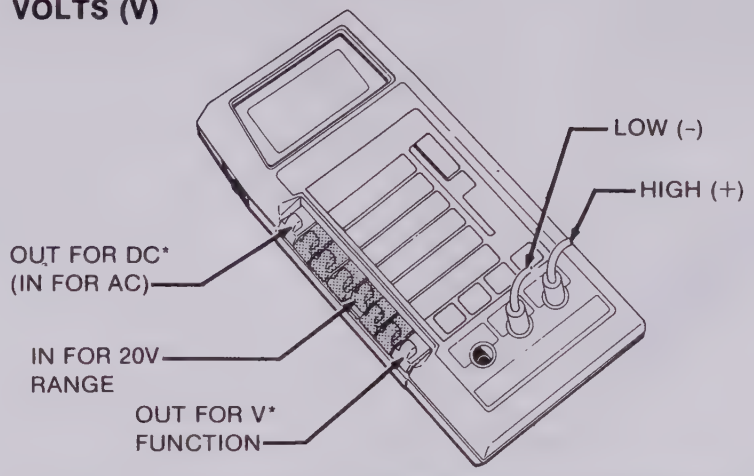
2. Keep the voltmeter out of high temperature, high humidity environments, such as, the dash of a car on a hot, sunny day. Otherwise, the display may temporarily turn black. Recovery occurs at normal operating temperature.

3. Note that the display operation may be slowed in extremely low temperature environments. No damage will occur to the LCD, but response time is greatly increased. Recovery occurs at normal operating temperature.

2-22. OPERATION

2-23. The five figures, 2-1 through 2-5, each illustrate one of the measurement functions of the Model 8020B. Each figure has two parts. The top part shows your 8020B as it should look when ready to perform that type of measurement. The bottom part of the figure lists, in sequential order, the steps you should perform to make that type of measurement with your 8020B. To operate your 8020B turn to the operation figure corresponding to the measurement function desired and perform the steps listed in the figure. Operate the Model 8020B in accordance with the Input Overload Protection and the Input Connections to COMMON portions of the Operating Notes presented earlier in this section.

VOLTS (V)



**NOTE: The Function switches are push-push type. Operate these switches by pushing to the RIGHT▶only! Do not push or pull these switches to the left (out or off) positions.*

- Connect the test leads as shown above.
- Depress the switch beside the range desired (20V is shown selected).
- Set the AC/DC switch out for DC or in For AC (DC is shown selected).
- Ensure that all other switches are at the out or off positions.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE 8020B TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING VOLTAGES:

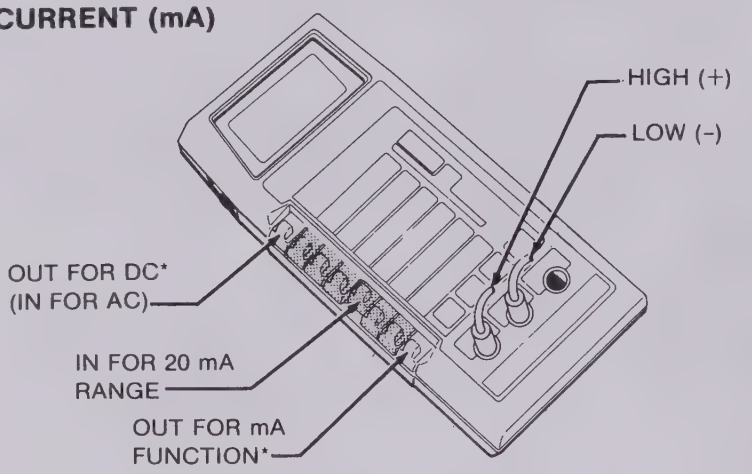
COMMON: 500V DC OR RMS AC WITH RESPECT TO EARTH GROUND.

V-Ω-S: 1000V DC OR 750V RMS AC WITH RESPECT TO THE COMMON TERMINAL (INTHE AC FUNCTION, 200 mV RANGE, SOURCES GREATER THAN 300V DC OR RMS AC SHOULD NOT BE CONNECTED LONGER THAN 15 SECONDS).

- Connect the test leads to the circuit being measured.
- Read the measured value on the display. The minus sign will appear if the V-Ω-S terminal is negative with respect to the COMMON terminal.

Figure 2-1. Volts Operation

CURRENT (mA)



**NOTE: The Function switches are push-push type. Operate these switches by pushing to the RIGHT▶only! Do not push or pull these switches to the left (out or off) positions.*

- Connect the test leads as shown.
- Depress the switch beside the range desired (20 mA range shown selected).
- Set the AC/DC switch out for DC or in for AC.
- Ensure that all other switches are at the out or off positions.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE 8020B TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING CURRENT:

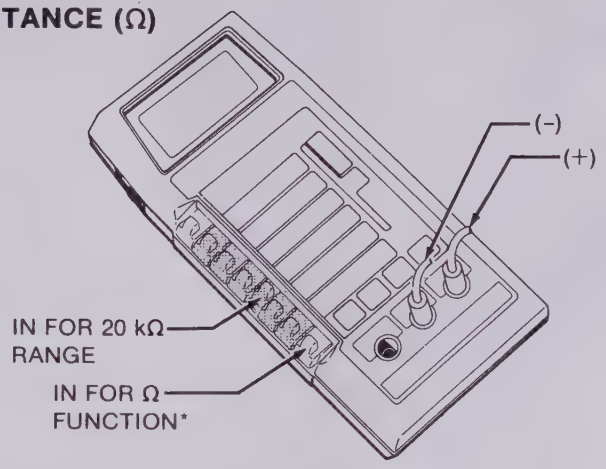
COMMON: 500V DC OR RMS AC WITH RESPECT TO EARTH GROUND.

mA: CURRENT OF 2 AMPS OR OPEN CIRCUIT VOLTAGE OF 600V DC/RMS AC. DO NOT ATTEMPT CURRENT MEASUREMENT WHERE THE POTENTIAL IS ABOVE 600V DC OR RMS AC.

- Connect the test leads to the circuit being measured.
- Read the measured value on the display. In DC the minus sign will appear if the mA terminal is negative with respect to the COMMON terminal. If unit fails to read properly, see Fuse Check located earlier in this section.

Figure 2-2. Current Operation

RESISTANCE (Ω)



**NOTE: The Function switches are push-push type. Operate these switches by pushing to the RIGHT▶only! Do not push or pull these switches to the left (out or off) positions.*

- Connect the test leads as shown.
- Depress the mA-V-Ω-S switch.
- Depress the switch beside the range desired (20k is shown selected).
- Ensure that all other switches are at the out or off positions.
- Make sure that the device being measured contains no electrical energy.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE 8020B TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING RESISTANCE OR CONTINUITY:

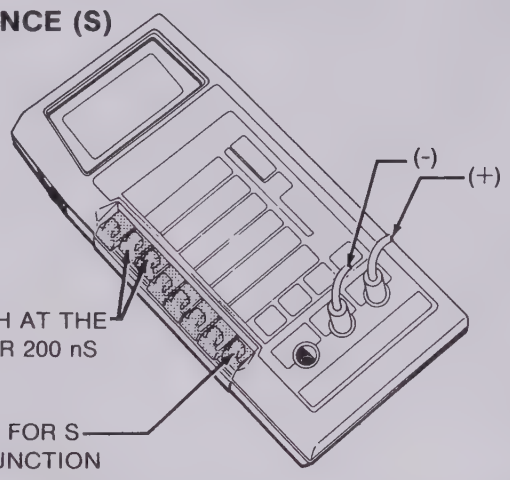
COMMON: 500V DC OR RMS AC WITH RESPECT TO EARTH GROUND.

V-Ω-S: 500V DC OR RMS AC WITH RESPECT TO THE COMMON TERMINAL. (15 SECONDS MAXIMUM ABOVE 300V.)

- Connect the test leads across the device being measured.
- Read the measured value on the display.

Figure 2-3. Resistance Operation

CONDUCTANCE (S)



**NOTE*

The Function switches are push-push type. Operate these switches by pushing to the RIGHT only! Do not push or pull these switches to the left (out or off) positions.

- Connect the test leads as shown.
- Depress the mA-V-Ω-S function switch.
- AT THE SAME TIME, depress both of the range switches. (The 200 nS range is shown selected.)
- Ensure that all other switches are at the out or OFF positions.
- Ensure that the device being measured contains no electrical energy.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE 8020B TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING VOLTAGES:

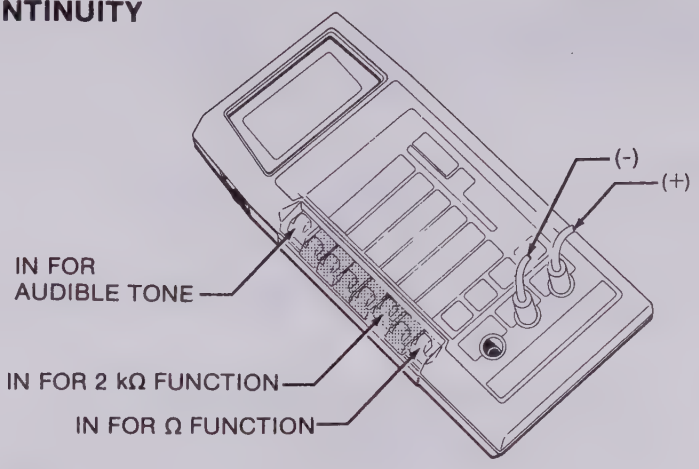
COMMON: 500V DC OR RMS AC WITH RESPECT TO EARTH GROUND.

V-Ω-S: 500V DC OR RMS AC WITH RESPECT TO THE COMMON TERMINAL. (15 SEC MAX ABOVE 300V.)

- Connect the test leads across the device being measured.
- Read the measured value in the display.
- See Measurement Techniques section for Conductance-Resistance Conversion chart.

Figure 2-4. Conductance Operation

CONTINUITY



**NOTE*

The Function switches are push-push type. Operate these switches by pushing to the RIGHT only! Do not push or pull these switches to the left (out or off) positions.

- Connect the test leads as shown.
- Depress the mA-V-Ω-S function switch.
- Depress the 2 kΩ range switch.
- Depress the AC/DC function switch.
- Ensure that all other switches are at the out or off position.
- Ensure that the device being measured contains no electrical energy.

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE, DO NOT CONNECT THE 8020B TERMINALS TO SOURCES THAT EXCEED THE FOLLOWING LIMITS WHEN MEASURING CONDUCTANCE:

COMMON: 500V DC OR RMS AC WITH RESPECT TO EARTH GROUND.

V-Ω-S: 500V DC OR RMS AC WITH RESPECT TO THE COMMON TERMINAL. (15 SEC MAX ABOVE 300V.)

- Connect the leads to the circuit being measured.
- Continuity between the test leads will cause the audible tone to sound.

Figure 2-5. Continuity Operation

2-24. MEASUREMENT TECHNIQUES

2-25. The following paragraphs offer you techniques that improve the measurement accuracy of your 8020B. While these techniques arein general use throughout the electronics industry, these paragraphs offer specific information for use with your 8020B.

2-26. AC Measurement

2-27. The ac ranges of the 8020B employ an average responding ac converter. This means that the unit measures the average value of the input, and displays it as an equivalent rms value for a sine wave. As a result, measurement errors are introduced when the input wave form is distorted (non-sinusoidal). The amount of error depends upon the amount of distortion. Figure 2-6 shows the relationship between sine, square and triangular waveforms, and the required conversion factors.

2-28. Voltage AC/DC

2-29. The 8020B is equipped with five ac and five dc voltage ranges; 200 mV, 2V, 20V, 200V, 750V ac/1000V dc. All ranges present an input impedance of 10 MΩ. On the ac ranges, this is shunted by less than 100 pF. When making measurements, be careful not to exceed the overload limits given earlier in Table 2-1.

2-30. Measurement errors, due to circuit loading, can result when making either ac or dc voltage measurements on circuits with high source resistance. However, in most cases the error is negligible (≤0.1%) as long as the source resistance of the measurement circuit is 10 kΩ or less. If circuit loading does present a problem, the percentage of error can be calculated using the appropriate formula in Figure 2-7.

2-31. Current AC/DC

WARNING

INSTRUMENT DAMAGE AND OPERATOR INJURY MAY RESULT IF THE FUSE BLOWS WHILE CURRENT IS BEING MEASURED IN A CIRCUIT WHICH EXHIBITS AN OPEN CIRCUIT VOLTAGE GREATER THAN 600V. DO NOT ATTEMPT AN IN-CIRCUIT CURRENT MEASUREMENT WHERE THE POTENTIAL IS GREATER THAN 600V DC OR RMS AC.

2-32. Four ac and four dc current ranges are included on the 8020B; 2 mA, 20 mA, 200 mA, and 2000 mA. Each range is diode protected to 2 amps and fuse protected above 2 amps. If either fuse blows, refer to fuse replacement information given earlier in this section.

2-33. In high electrical noise environments (near ignition switches, flourescent lights, relay switches, etc.) unstable or erroneous readings (exceeding specifications) may occur. The effect is most obvious when measuring low level current on the 2 mA range. If an erratic or erroneous reading is suspected, temporarily jumper the V/Ω connector to the mA connector. This is recommended for the 2 mA and 20 mA ranges only.

CAUTION

To avoid possible instrument damage and/or erroneous measurements remove the temporary V/Ω-to-mA jumper before attempting voltage or resistance measurements.

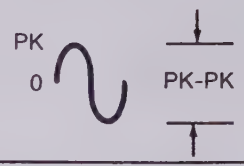
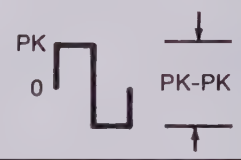
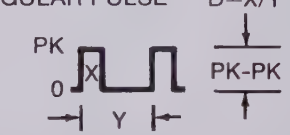
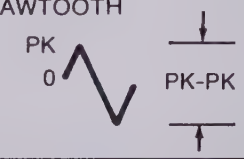
INPUT WAVEFORM	DISPLAY MULTIPLIER FOR MEASUREMENT CONVERSION			
	PK-PK	0-PK	RMS	AVG
SINE 	2.828	1.414	1.000	0.900
RECTIFIED SINE (FULL WAVE)	1.414	1.414	1.000	0.900
RECTIFIED SINE (HALF WAVE)	2.828	2.828	1.414	0.900
SQUARE 	1.800	0.900	0.900	0.900
RECTIFIED SQUARE	1.800	1.800	1.272	0.900
RECTANGULAR PULSE D=X/Y 	0.9/D	0.9/D	$0.9/D^{1/2}$	0.9D
TRIANGLE SAWTOOTH 	3.600	1.800	1.038	0.900

Figure 2-6. Waveform Conversion

1. DC VOLTAGE MEASUREMENTS

Loading Error in % = 100 x Rs ÷ (Rs + 10^7)
Where: Rs = Source resistance in ohms of circuit being measured.

2. AC VOLTAGE MEASUREMENTS

First, determine input impedance, as follows: *

$$Z\,in = \frac{10^7}{\sqrt{1 + (2\pi F \bullet Rin \bullet C)^2}}$$

Where: Zin = effective input impedance
Rin = 10^7 ohms
Cin = 100 x 10^{-12} Farads
F = frequency in Hz

Then, determine source loading error as follows: *

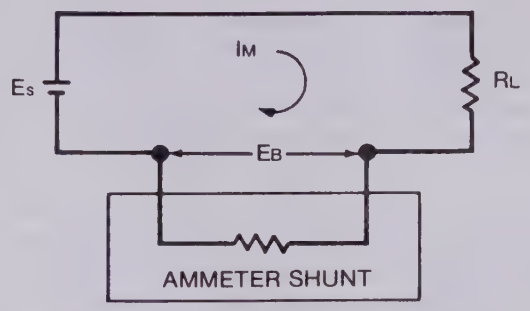
$$\text{Loading Error in \%} = \frac{100 \times Zs}{Zs + Zin}$$

Where: Zs = source impedance
Zin = input impedance (calculated)

*Vector algebra required

Figure 2-7. Voltage Measurement Error Calculations

2-34. Full-scale burden voltage (voltage drop across the fuse and current shunt) for all ranges except 2000 mA is less than 300 mV. The 2000 mA range has a full-scale burden voltage of less than 900 mV. These voltage drops can affect the accuracy of a current measurement, if the current source is unregulated and the shunt plus fuse resistance represents a significant portion (1/1000 or more) of the source resistance. If burden voltage does present a problem, the percentage of error can be calculated using the formula in Figure 2-8. This error can be minimized by using the highest current range that gives the necessary resolution. For example, if 20 mA is measured on the 2000 mA range the burden voltage is approximately 5 mV.



E_S = Source voltage
R_L = Load resistance + Source resistance
I_M = Measured current (display reading in mA)
E_B = Burden voltage (calculated), i.e., Display reading expressed as a % of full-scale ($100 \times \frac{\text{READING}}{\text{FULL-SCALE}}$) times full-scale burden voltage for selected range. See Table.

RANGE	MAXIMUM BURDEN VOLTAGE
2 mA to 200 mA	0.3V
2000 mA	0.9V

Maximum current error due to Burden Voltage

$$\text{IN \%} = 100 \times \frac{E_B}{E_S - E_B}$$

$$\text{IN mA} = \frac{E_B \times I_M}{E_S - E_B}$$

Example: $E_S = 14V$, $R_L = 9\Omega$, $I_M = 1497$ mA,

$$E_B = 100 \times \frac{1497}{2000} \times 0.9 \text{ (from Table)} =$$

$$74.9\% \times 0.9 = 0.674V$$

$$\text{Error in \%} = 100\,\frac{.674}{14 - .674} = 100\,\frac{.674}{13.326} = 5.06\%$$

Increase displayed current by 5.06% to obtain true current.

$$\text{Error in mA} = \frac{.674 \times 1497}{14 - .674} = \frac{1009}{13.326} = 76 \text{ mA}$$

Increase displayed current by 76 mA to obtain true current.

Figure 2-8. Current Measurement Error Calculations

2-35. Resistance

2-36. Six direct reading resistance scales are provided on the 8020B: 20 MΩ, 2000 kΩ, 200 kΩ, 20 kΩ, 2 kΩ and 200Ω. All scales employ a two-wire measurement technique. As a result, test lead resistance may influence measurement accuracy on the 200Ω range. To determine the error, short the test leads together and read the lead resistance. Correct the measurement by subtracting the lead resistance from the measurement reading. The error is generally on the order of 0.2 to 0.3 ohms for a standard pair of test leads.

2-37. In-circuit resistance measurements can be made using the 200Ω, 20 kΩ and 2000 kΩ ranges. The full scale measurement voltage produced on these ranges is not sufficient to forward bias silicon diode/emitter-base junctions, and thus, enables resistance values to be measured without removing diodes and transistors from the circuit. Conversely, the 2 kΩ, 200 kΩ, and 20 MΩ ranges produce a measurement voltage sufficient to forward bias a P-N junction. These ranges enable both diode- and transistor-junction checks to be made conveniently. Full scale voltage and short circuit current for each resistance range is given in Table 2-2. All values shown are referenced to the COMMON input terminal; i.e., the V/Ω/S terminal is positive.

NOTE

Any change (greater than one or two digits) in apparent resistance when test leads are reversed may indicate either the presence of a diode junction or a voltage in the circuit.

CAUTION

Turn test circuit power off and discharge all capacitors before attempting in-circuit resistance measurements.

2-38. Three of the 8020B resistance ranges have a high enough open-circuit voltage to turn on a silicon junction. These ranges (2 kΩ, 200 kΩ, and 20 MΩ) can be used to check silicon diodes and transistors. The 2 kΩ range is preferred for this function and is marked with a diode symbol. The open-circuit voltage of the three alternate ranges (200Ω, 2kΩ, and 2 MΩ) is not high enough to turn on a silicon junction. Use these three ranges to make in-circuit resistance measurements. For all resistance ranges, the V/Ω/S input terminal is positive with respect to the COMMON input terminal.

Table 2-2. Voltage/Current Capability of Resistance Ranges

RANGE	FULL-SCALE VOLTAGE (TYPICAL)	SHORT CIRCUIT CURRENT (TYPICAL)
20 MΩ	+800 mV	+0.12 μA
2000 kΩ	+200 mV	+0.12 μA
200 kΩ	+800 mV	+12 μA
20 kΩ	+200 mV	+12 μA
2 kΩ→|	+1.1V	+1.0 mA
200Ω	+55 mV	+0.3 mA

2-39. Continuity

2-40. Audibly confirmed continuity measurements may be made using any of the resistance or conductance ranges. The 2 kΩ range is recommended for this mode since it provides the lowest resistance threshold, approximately 110 ohms. On this range a measured resistance lower than 110 ohms initiates the audible tone. To determine the exact threshold, use a variable resistor and note the display reading at which the tone switches on and/or off.

2-41. Intermittent open or short circuits with a duration of at least 50 us are detectable on all continuity ranges. A continuously intermittent connection is heard as a series of beeps. A series of beeps (due to environmental noise) is also encountered when a measurement is near the threshold of the selected range. The approximate thresholds for the continuity ranges are as follows:

RANGE	THRESHOLD
200 nS	900 kilohms
2 mS	110 ohms
20 MΩ	900 kilohms
2000 kΩ	900 kilohms
200 kΩ	9 kilohms
20 kΩ	9 kilohms
2 kΩ	110 ohms
200Ω	360 ohms

2-42. Conductance

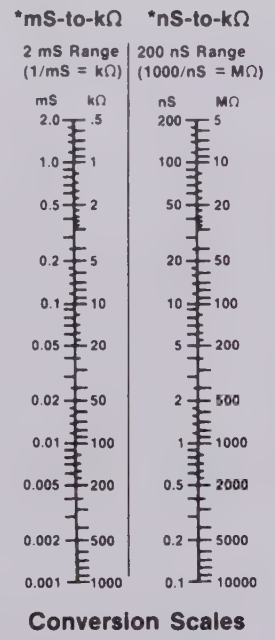
2-43. The conductance ranges, (200 nS and 2 mS) are included on the 8020B for making both conductance and resistane measurements. When either range is selected the display reads the measurement results in terms of conductance (1/Ω). If resistance readings are required, refer to the conductance-to-resistance conversion information given in Figure 2-9.

2-44. The 200 nS range is intended for use in making fast, accuracte, high-resistance measurements from 5 MΩ to 10,000 MΩ. Ordinarily, resistance measurements within this range are plagued by noise pick-up and require careful shielding. However, by measuring the resistance in terms of conductance, standard test leads are adequate for the 8020B to make noise-free measurements up to 10,000 MΩ. High value resistors, and low leakage components (i.e., diodes, etc.) are natural candidates for the 200 nS conductance range. Refer to applications later in this section for additional information.

2-45. The 2 mS range, in terms of resistance, starts at 500Ω and goes up to 1 MΩ. It is intended for use in making either resistance measurements or direct-reading dc current gain (beta) measurements on transistors. Beta measurements require the use of a special test fixture, and are discussed later in this section under applications.

2-46. APPLICATIONS

2-47. The applications described in the following paragraphs are suggested as useful extensions of the 8020B measurement capabilities. However, they are not intended as the equivalent of a manufacturer's recommended test methods. Rather, they are intended to provide repeatable and meaningful indications which will allow operator to make sound judgments concerning the condition of the device being tested; i.e., good, marginal, or defective.



Conversion Scales

* *S= siemens=1/Ω=International unit of conductance formerly known as the mho.*

Find the approximate resistance value using one of the scales at left. Then, on the table below, locate the most significant digit of the display reading on the vertical NO. column, and the next digit on the horizontal NO. row. The number at the intersecting coordinates represents the unknown resistance value. For example, a reading of 52.0 nS is equal to 19.2 MΩ. Decimal point location is determined from the scale approximation.

Interpolation Table (1/no.)

NO.	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1	1	.909	.833	.769	.714	.667	.625	.588	.556	.526
2	.500	.476	.455	.435	.417	.400	.385	.370	.375	.345
3	.333	.323	.313	.303	.294	.286	.278	.270	.263	.256
4	.250	.244	.238	.233	.227	.222	.217	.213	.208	.204
5	.200	.196	.192	.187	.185	.182	.179	.175	.172	.169
6	.167	.164	.161	.159	.156	.154	.152	.149	.147	.145
7	.143	.141	.139	.137	.135	.133	.132	.130	.128	.127
8	.125	.123	.122	.121	.119	.118	.116	.115	.114	.112
9	.111	.110	.109	.108	.106	.105	.104	.103	.102	.101

Figure 2-9. Conductance-to-Resistance Conversion

2-48. Transistor Tester

NOTE

The transistor tester described in the following paragraphs provides approximate test information. Beta is measured using a VCE of about 2V and an IC of about 200 μA. The test method is very useful for making comparative and matching measurements.

2-49. Select the 2 mS range, plug the fixture shown in Figure 2-10 into the V/Ω/S and COMMON input terminals, and you have tranformed your 8020B into a transistor tester. Now, plug a transistor into the test socket and the 8020B will determine the following:

1. Transistor type (NPN or PNP).
2. Collector-to-emitter leakage (ICEs).
3. Beta from 1 to 1000 without changing range.

2-50. Transistor type is determined by setting the switch on the fixture to BETA and observing the display. If a low reading (≤0.010) is obtained, reverse the test fixture at the input terminals. If the collector is now positioned at the COMMON input terminal, the transistor is a PNP type. An NPN type will have its collector positioned at the V/Ω/S input terminals. If the transistor is defective the indications will be as follows regardless of fixture position:

1. A shorted transistor will cause an overload indication.
2. An open transistor will read 0.001 or less.

2-51. After the transistor fixture is properly positioned, set the switch to ICEs for the leakage test. The transistor is turned off in this test (base shorted to emitter), and should appear as a very low conductance (high resistance) from collector-to-emitter. Therefore, the lower the reading, the lower the leakage. Silicon transistors that read more than 0.002 (6 μA) should be considered questionable.

2-52. Beta is determined by setting the fixture switch to BETA, and observing the display. Mentally shift the decimal point three places to the right and read beta directly. For example, a display reading of 0.127 indicates a dc current gain (beta) of 127.

NOTE

Beta is a termperature sensitive parameter. Therefore, repeatable readings can only be obtained by allowing the transistor to stabilize at the ambient temperature while being tested. Avoid touching the transistor's case with your fingers.

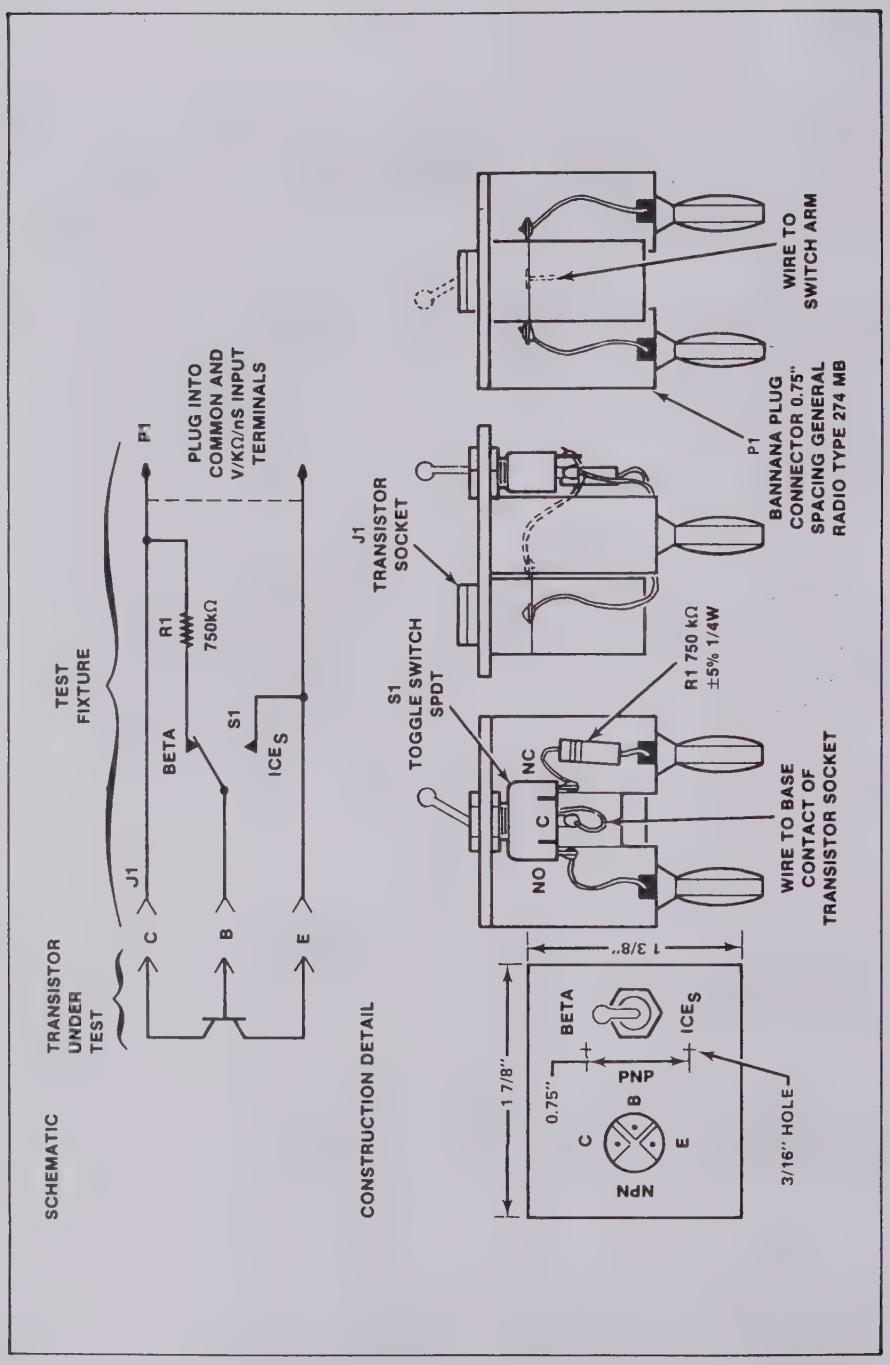


Figure 2-10. Transistor Beta Test Fixture

2-53. Leakage Tester

2-54. The 200 nS conductance range effectively extends the resistance measurement capability of the 8020B (up to 10,000 MΩ) to the point where it can be used to provide useful leakage measurements on passive components. For example, you can detect leaky diodes, cables, connectors, printed circuit boards (pcbs), etc. In all cases, the test voltage is <5V dc.

2-55. RESISTIVE COMPONENTS

2-56. Leakage testing on purely resistive components such as cables and pcbs is straightforward. Select the 200 nS range, install the test leads in the V/Ω/S and COMMON input terminals, connect the leads to the desired test points on the unit-under-test, and read leakage in terms of conductance. If an overrange occurs, select a resistance range that provides an on-scale reading.

NOTE

Under high humidity conditions (>80%) conductance measurements may be in error. To ensure accurate measurements connect clean test leads to the 8020B and (with the leads open) read the residual leakage in nanosiemens. Correct subsequent measurements by subtracting the residual from the readings. (Finger prints or other contamination on the pcb may also cause residual conductance readings.)

2-57. DIODES

2-58. Diode leakage (IR) tests require that the diode junction be reverse biased when being measured. This is accomplished by connecting the anode of the diode to the COMMON input terminal and its cathode to the V/Ω/S input terminal. Leakage can then be read in terms of conductance. In the event of an overrange, select a resistance range that provides an on-scale reading.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a block diagram analysis of the 8020B. A detailed schematic of the 8020B appears in Section 7.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. The Model 8020B as shown in Figure 3-1, is a hand-held 8 function digital multimeter. It features a total of 26 measurement ranges (dc volts-five, ac volts-five, ohms-six, dc current-four, ac current-four, and conductance-two); a high contrast, easy-to-read, 3-1/2 digit liquid crystal display; long battery life (up to 200 hours); and overload protection for all ranges.

3-5. Operation centers around a custom LSI chip, U1, which contains a dual slope a/d converter and a display driver. Peripherals to U1 include range and function switches, input signal conditioners, and the display. When an input signal is applied to the 8020B it is routed through the range switches to one of four input signal conditioners as determined by the function switch setting. Each conditioner scales and, if necessary, rectifies the input so that an acceptable dc input level (–0.2 to +0.2V dc) is presented to the a/d converter.

3-6. Timing for the overall operation of the a/d converter is derived from an external quartz crystal whose frequency is a multiple of the local line frequency. This allows the conditioned dc input data to be integrated over a single line cycle, thus optimizing both common mode and normal mode rejection.

3-7. Digitized measurement data is presented to the display as four decoded digits (seven segments) plus polarity. Decimal point position on the display is determined by the range switch settings.

3-8. BLOCK DIAGRAM ANALYSIS

3-9. A/D Converter

3-10. The entire analog-to-digital conversion process is accomplished by a single custom A/D Converter and Display Driver IC, U1. The IC employs the dual slope method of a/d conversion, and requires a series of external components to establish the basic timing and reference levels required for operation. These include an integrating capacitor, an

autozero capacitor, and a flying capacitor (for applying a reference level of either polarity). Since the power consumed for display operation is very low, the IC also contains the latches, decoders, and drivers required for the display.

3-11. The digital control portion of the a/d conversion process is an internal function of U1, and is keyed to the external crystal frequency. As a result, the conversion process is continuously repeated, and the display is updated at the end of every conversion cycle.

3-12. A simplified circuit diagram of the analog portion of the a/d converter is shown in Figure 3-2. Each of the switches shown represent analog gates which are operated by the digital section of the a/d converter. Basic timing for switch operation and, therefore, a complete measurement cycle is also included in the figure.

3-13. Any given measurement cycle performed by the a/d converter can be divided into three consecutive time periods, autozero (AZ), integrate (INTEG), and read. Both autozero and integrate are fixed time periods whose lengths are multiples of the clock frequency. A counter determines the length of both time periods by providing an overflow at the end of every 10,000 clock pulses. The read period is a variable time which is proportional to the unknown input voltage. The value of the voltage is determined by counting the number of clock pulses that occur during the read period.

3-14. During autozero a ground reference is applied as an input to the a/d converter. Under ideal conditions the output of the comparator would also go to zero. However, input-offset-voltage errors accumulate in the amplifier loop, and appear at the comparator output as an error voltage. This error is impressed across the AZ capacitor where it is stored for the remainder of the measurement cycle. The stored level is used to provide offset voltage correction during the integrate and read periods.

3-15. The integrate period begins at the end of the autozero period. As the period begins, the AZ switch opens and the INTEG switch closes. This applies the unknown input voltage to the input of the a/d converter. The voltage is buffered and passed on to the integrator to determine the charge rate (slope) on the INTEG capacitor. By the end of the fixed integrate period the capacitor is charged to a level proportional to the unknown input voltage. This voltage is translated to a digital indication by discharging the capacitor at a fixed rate during the read period, and counting the number of clock pulses that occur before it returns to the original autozero level.

3-16. As the read period begins, the INTEG switch opens and the read switch closes. This applies a known reference voltage to the input of the a/d converter. The polarity of this voltage is automatically selected to be opposite that of the unknown input voltage, thus, causing the INTEG capacitor to discharge at a fixed rate (slope). When the charge is equal to the initial starting point (autozero level), the read period is ended. Since the discharge slope is fixed during the read period, the time required for discharge is proportional to the unknown input voltage.

3-17. The autozero period and, thus, a new measurement cycle begins at the end of the read period. At the same time the counter is released for operation by transferring its contents (previous measurement value) to a series of latches. This stored data is then decoded and buffered before being used for driving the liquid crystal display.

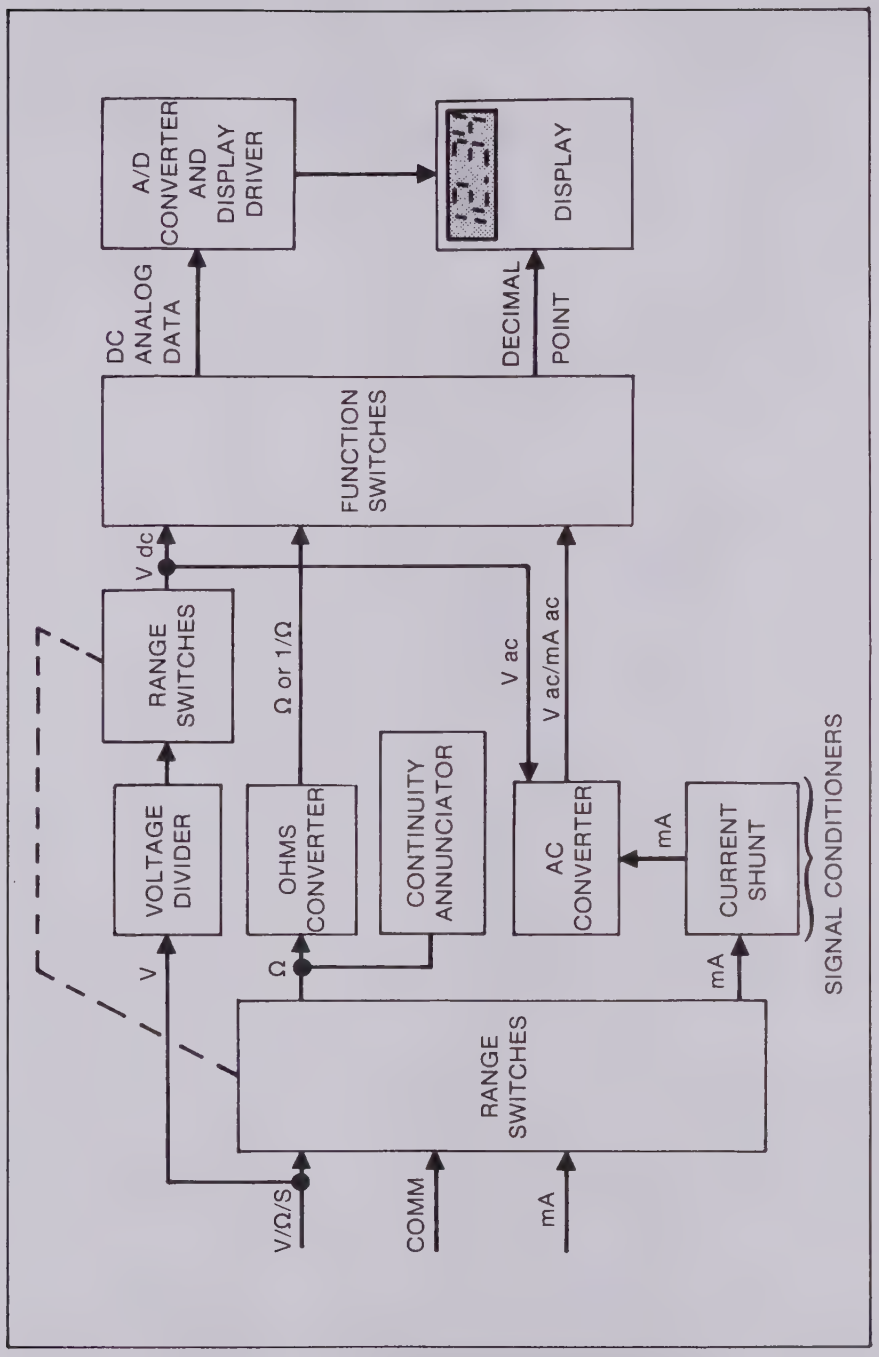


Figure 3-1. 8020B Simplified Block Diagram

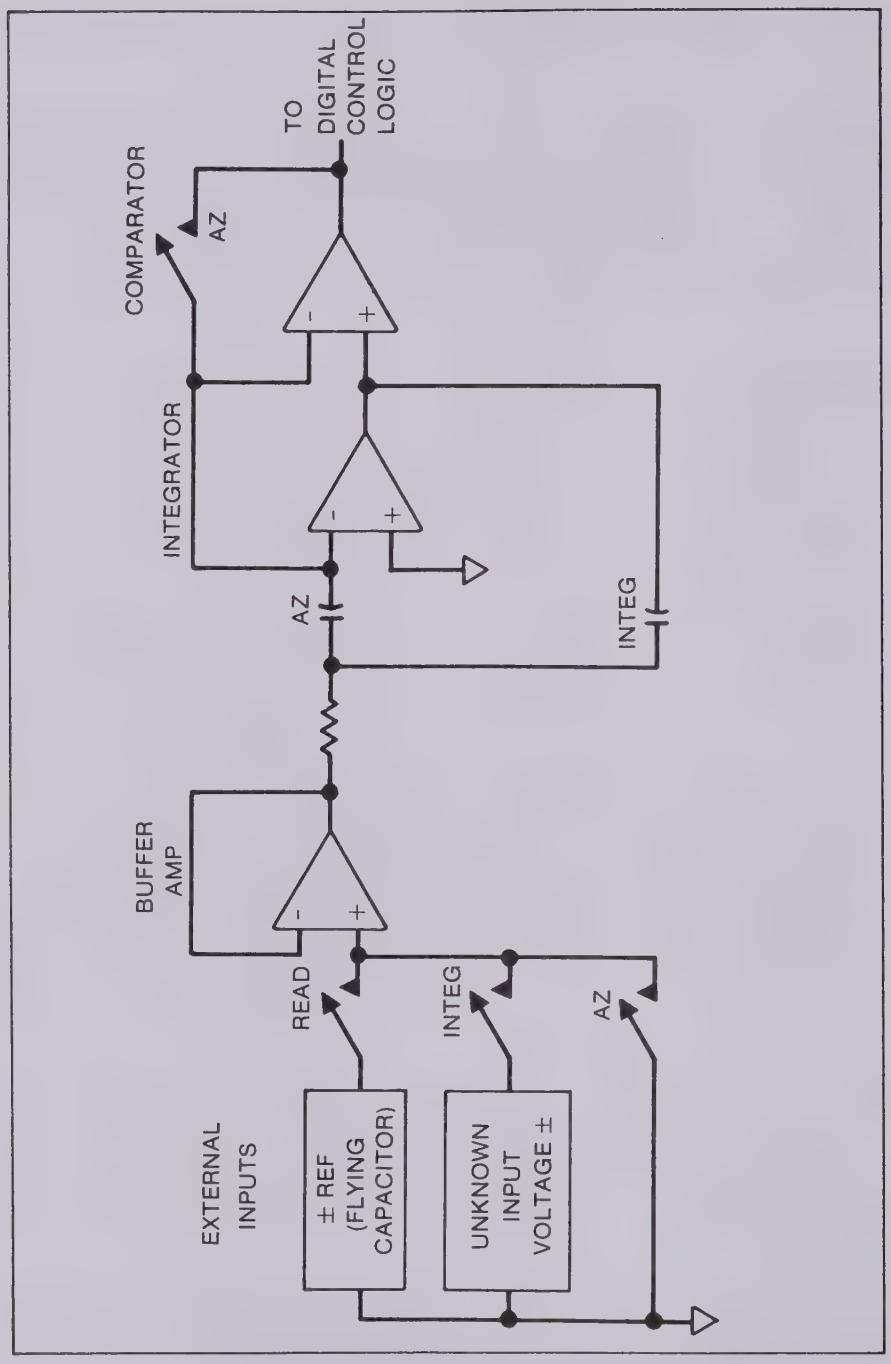


Figure 3-2. Dual Slope A/D Converter

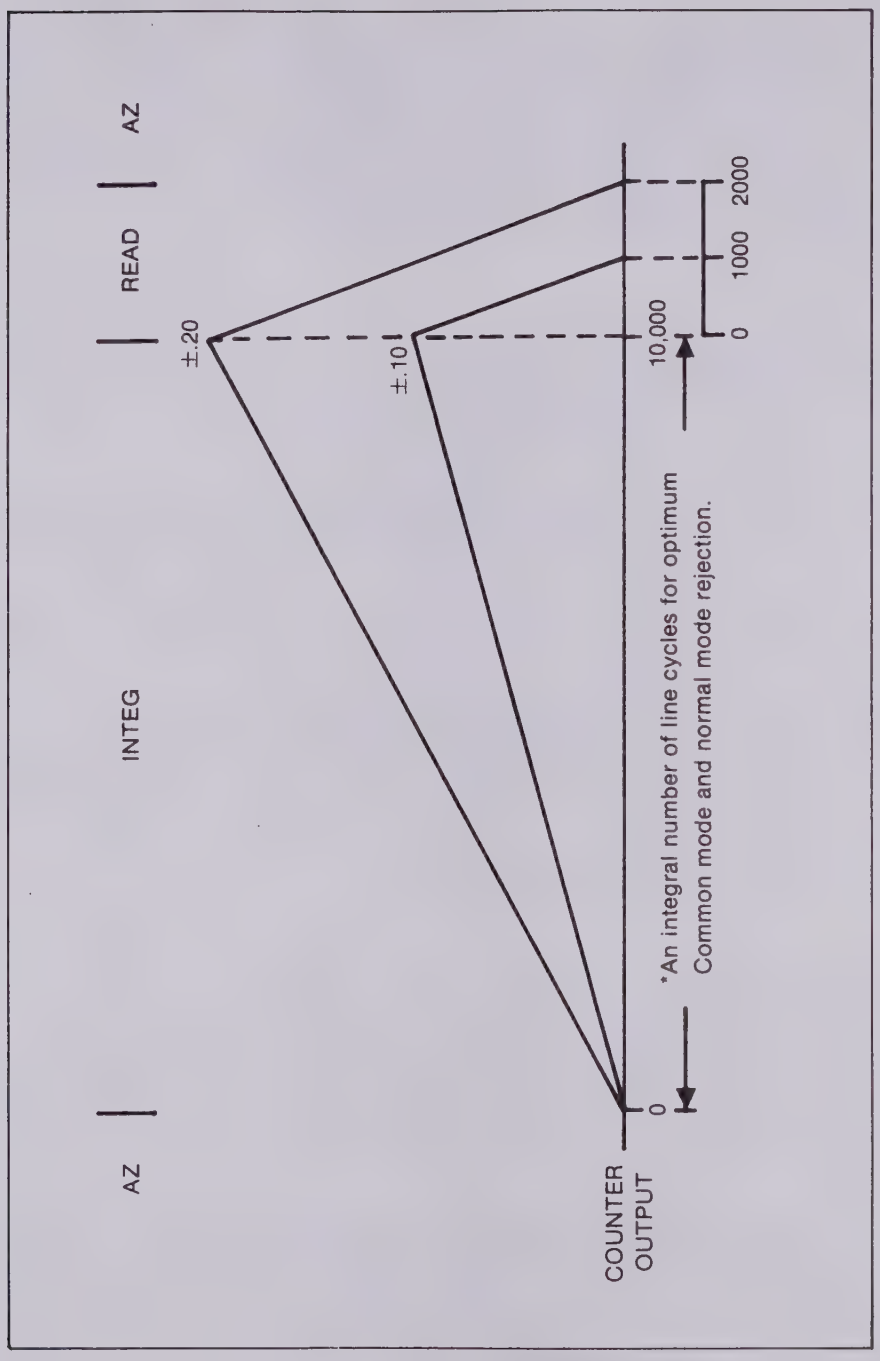


Figure 3-2. Dual Slope A/D Converter (cont)

3-18. Input Signal Conditioners

3-19. The a/d converter requires two externally supplied input voltages to complete a measurement cycle. One is reference voltage and the other is an unknown dc voltage within the range of -0.2 to +0.2V dc. If the function being measured is other than a dc voltage within the ±0.2 range, it must be scaled and/or conditioned before being presented to the a/d converter. for example, higher dc levels must be divided; ac inputs must be divided, rectified, and filtered; and resistance and current inputs must be scaled and converted to dc voltlage levels. The following paragraphs describe the input signal conditioners used for each of the 8020B measurement functions.

3-20. VOLTAGE MEASUREMENT

3-21. Both the ac and dc voltage ranges use an over-voltage-protected, 10 MΩ input divider as shown in Figure 3-3A. Under normal conditions, assuming a dc input level on the proper range, the divider output is a -0.2 to +0.2V dc signal, and is an exact (power-of-10) ratio of the input signal. If the VAC function is selected, the divider output is ac coupled to an active full-wave rectifier whose dc output is calibrated to equal the rms level of the ac inputs. The conditioned signal for the selected function (V ac or V dc) is then passed through a filter before being presented to the a/d converter as the unknown input.

3-22. CURRENT MEASUREMENT

3-23. Current measurements are made using a fuse protected, switchable, four-terminal current shunt (0.1Ω, 1Ω, 10Ω, or 100Ω) to perform the current-to-voltage conversion required by the a/d converter. See Figure 3-3B. The voltage (I R) drop produced across the selected shunt may be either ac or dc depending upon the selected function, mA AC or mA DC. If the input current is dc and the dc function is selected, the I R drop is passed through a low-pass filter, and presented as the unknown input to the a/d converter. However, if the input current is ac and the AC function is selected, the I R drop is rectified by the ac converter before going to the low-pass filter. In either event the a/d converter receives a dc input voltage proportional to the current passing through the selected shunt.

3-24. RESISTANCE MEASUREMENTS

3-25. Resistance measurements are made using a ratio technique as shown in Figure 3-3C. When the Ω function is selected, a simple series circuit is formed by the internal reference voltage, a reference resistor from the voltage divider (selected by range switches), and the external unknown resistor. The ratio of the two resistor values is equal to the ratio of their respective voltage drops. Therefore, since the value of one resistor is known, the value of the second can be determined by using the voltage drop across the known resistor as a reference. This determination is made directly by the a/d converter.

3-26. Overall operation of the a/d converter during a resistance measurement is basically as described earlier in this section, with one exception. The reference voltage present during a voltage measurement is replaced by the voltage drop across the reference resistor. This allows the voltage across the unknown resistor to be read during the integrate period, and compared against the reference resistor during the read period. As before, the length of the read period is a direct indication of the value of the unknown.

3-27. CONDUCTANCE MEASUREMENTS

3-28. Conductance measurements are made using a ratio technique similar to that used in making resistance measurements. See Figure 3-3C. The main difference is that only two ranges are provided (200 nS and 2 mS), and the function of the range and unknown resistors in the measurement cycle is reversed. That is, the voltage drop across the range resistor is used as the unknown input during the integrate period, and the voltage across the unknown resistor is used for the reference input during the read period. As a result the display provides a reading that is the reciprocal ($1/\Omega$) of the unknown input resistance, i.e., the higher the input resistance the lower the display reading.

3-29. CONTINUITY MEASUREMENTS

3-30. Continuity is a measurement feature that supplements the resistance and conductance measurement functions. The feature is enabled when the V/Ω and the AC/DC function switches are both pressed in. When a measurement is made, continuity is indicated by an audible tone. No tone indicates an open circuit or a circuit resistance above the threshold of the range selected.

3-31. The continuity circuit consists of a comparator, a one-shot, and a tone generator. See Figure 3-3D. During a measurement, R pull-up and V source develop a voltage across the measured resistance. The comparator compares this voltage against an internal 100 mV threshold reference. If the input voltage is greater than the 100 mV reference, the tone generator is not enabled, a no-continuity indication. Conversely, an indication of less than 100 mV causes the comparator to enable the tone generator which emits an audible continuity indication.

3-32. Since the values of V source and R pull-up vary with the selected range, it is convenient to think of the 100 mV threshold as a resistance threshold. The resistance threshold and the V source/ R pull-up values for each continuity range are given in the following list:

RANGE	R pull-up	V source (VOLTS)	THRESHOLD RESISTANCE
200Ω	4 kilohms	1.2 volts	360 ohms
2 kΩ	3 kilohms	2.8 volts	110 ohms
2 mS	3 kilohms	2.8 volts	110 ohms
20 kΩ	100 kilohms	1.2 volts	9 kilohms
200 kΩ	100 kilohms	1.2 volts	9 kilohms
2000 kΩ	10 megohms	1.2 volts	900 kilohms
20 MΩ	10 megohms	1.2 volts	900 kilohms
200 nS	10 megohms	1.2 volts	900 kilohms

3-33. Extremely short changes in a continuity condition (intermittent open or short circuits) are detected by the one-shot, and the appropriate indication is maintained for approximately 200 ms. This pulse stretching effect ensures that a reliable audio tone is generated for continuity changes as short as 50 μs.

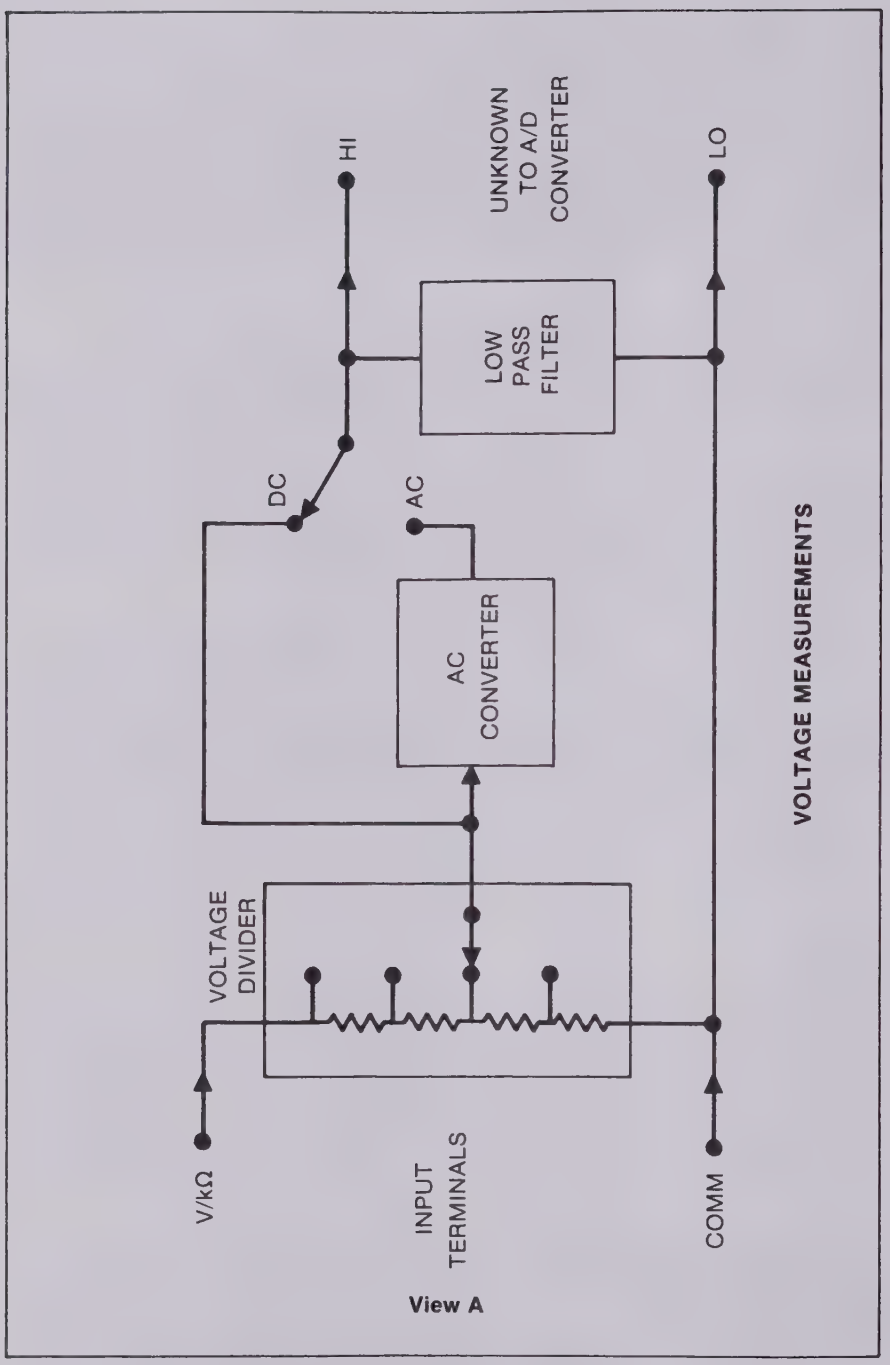


Figure 3-3. Input Signal Conditioners

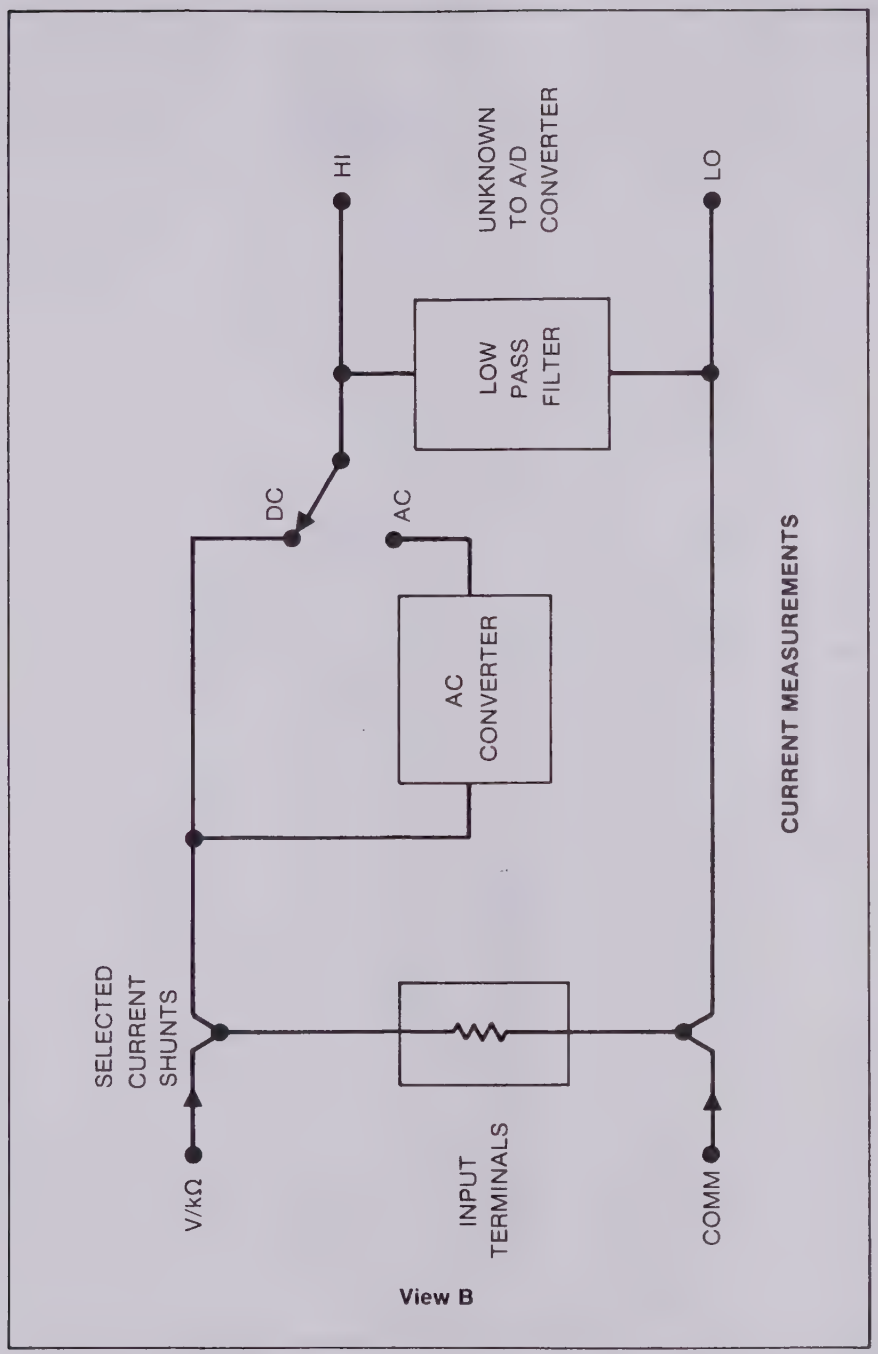


Figure 3-3. Input Signal Conditioners (cont)

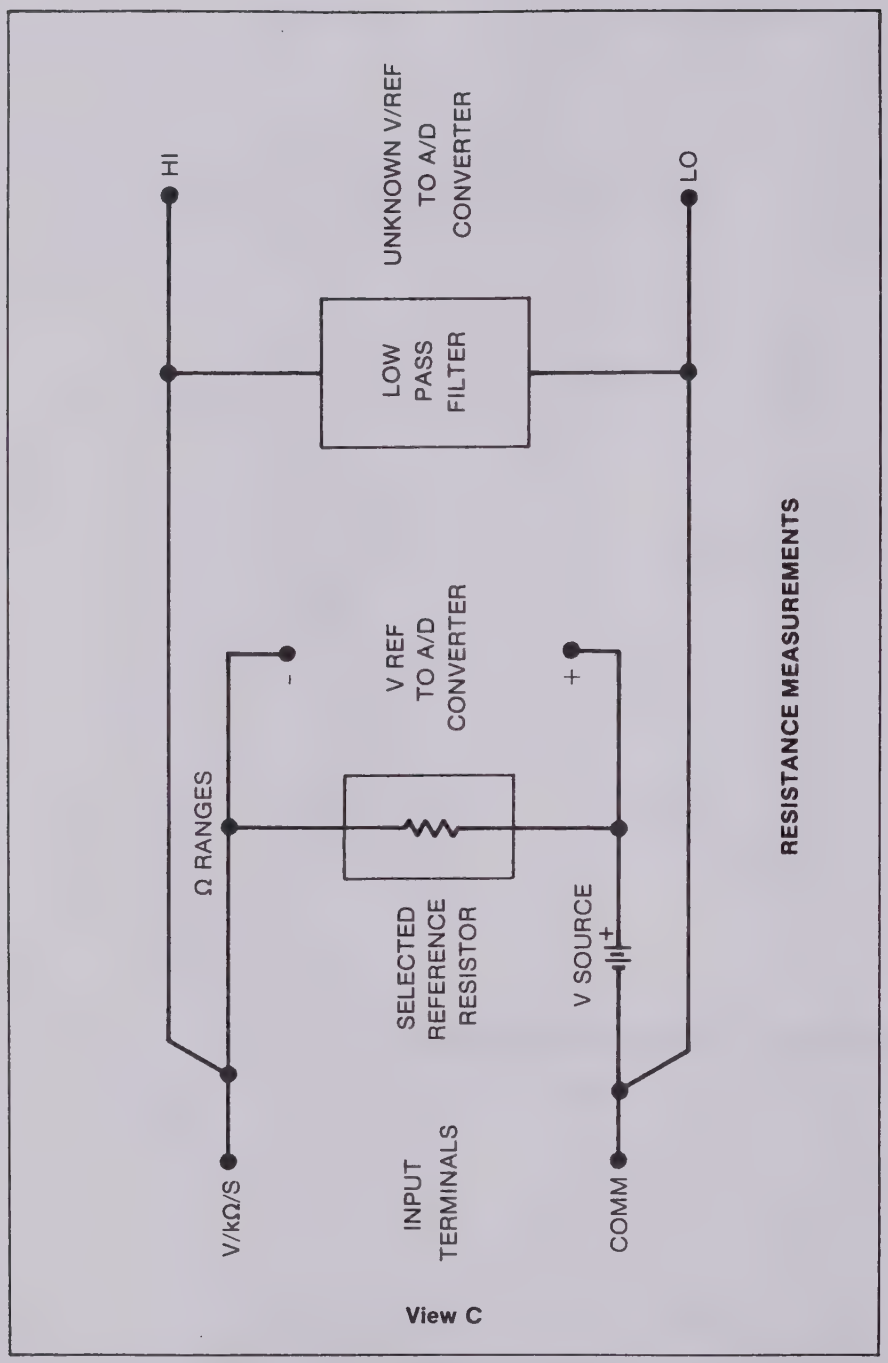


Figure 3-3. Input Signal Conditioners (cont)

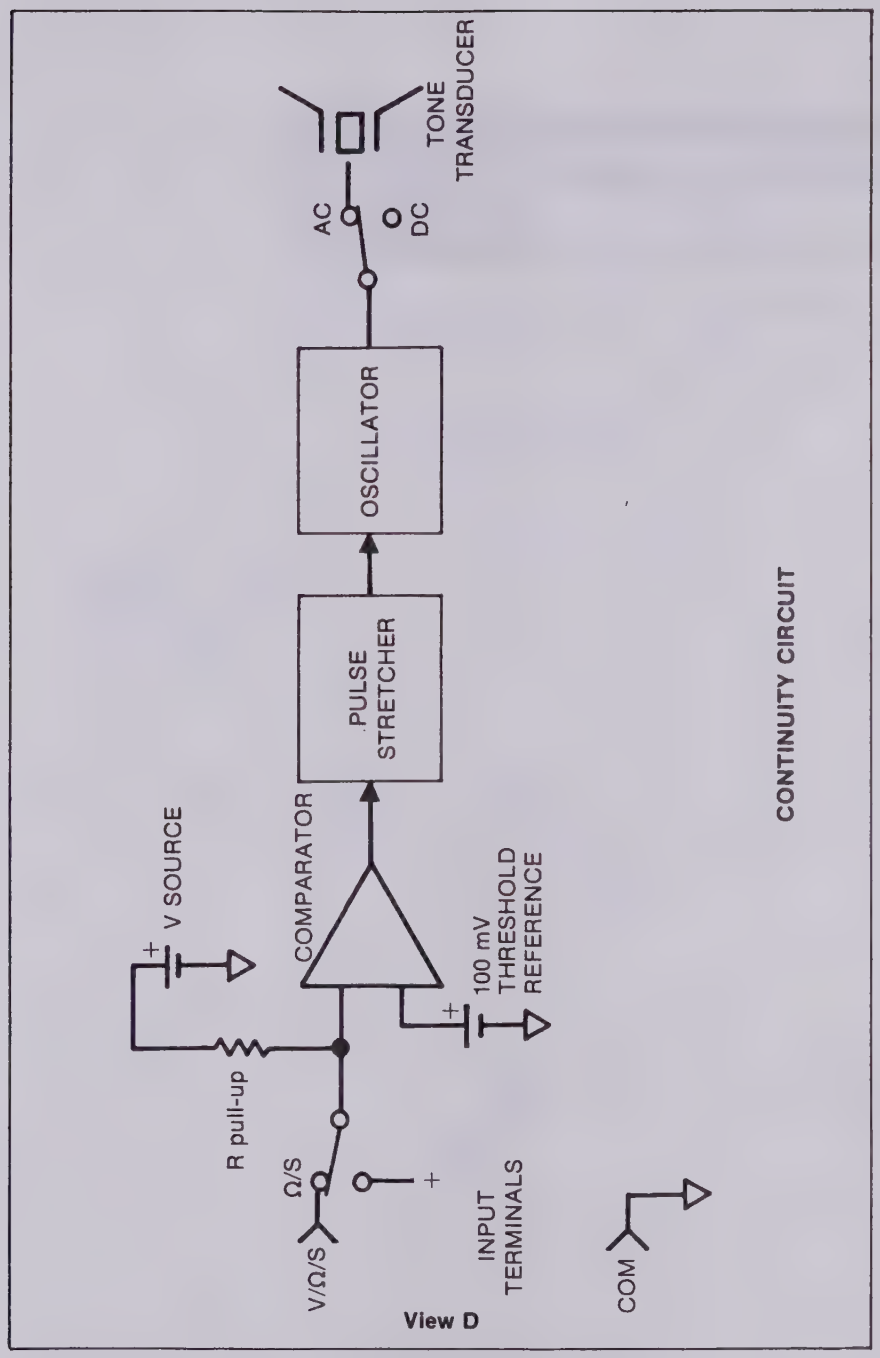
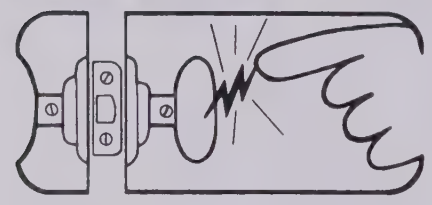


Figure 3-3. Input Signal Conditioners (cont)

static awareness

A Message From

John Fluke Mfg. Co., Inc.

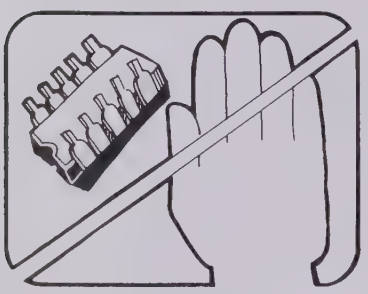


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

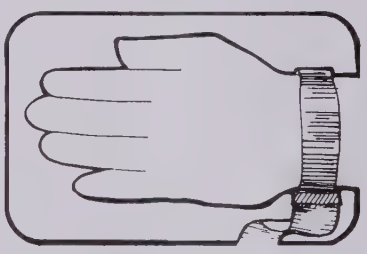
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "Ⓢ".

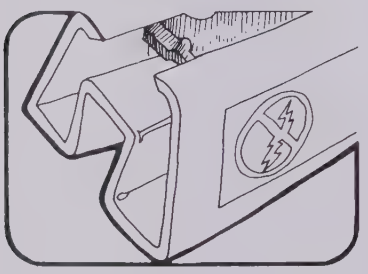
The following practices should be followed to minimize damage to S.S. devices.



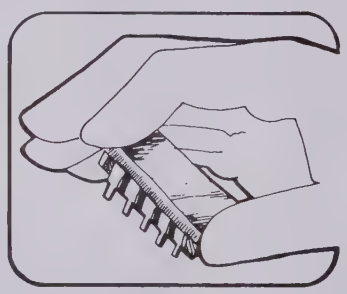
1. MINIMIZE HANDLING



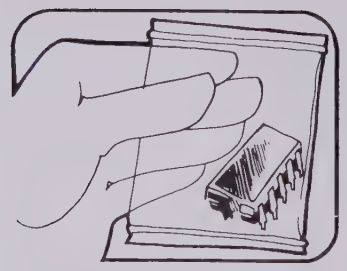
3 DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



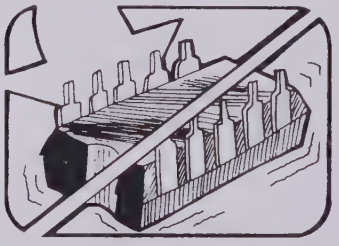
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



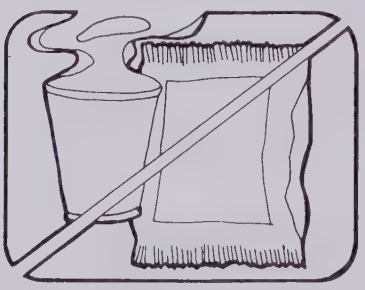
4. HANDLE S.S. DEVICES BY THE BODY



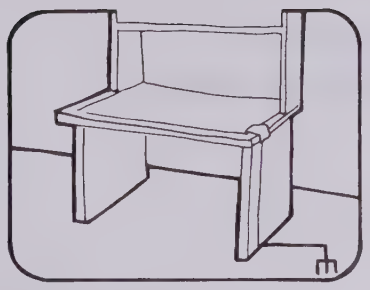
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 4
Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 8020B. This includes service information, general maintenance, performance test, calibration and troubleshooting. The performance test is recommended as an acceptance test when the unit is first received, and later as a preventive maintenance tool to verify proper instrument operation. A 2-year calibration cycle is recommended to maintain the specifications given in Section 1 of this manual. The test equipment required for both the performance test and calibration is listed in Table 4-1. If the recommended equipment is not available, instruments having equivalent specifications may be used.

4-3. SERVICE INFORMATION

4-4. The 8020B is warranted for a period of two years upon delivery to the original purchaser. Conditions of the warranty are given at the rear of this manual.

4-5. Malfunctions that occur within the limits of the warranty will be corrected at no charge. Simply mail the instrument (postpaid) to your nearest authorized (in-warranty) Fluke Technical Service Center. A complete list of service centers are provided at the rear of this manual. Dated proof-of-purchase will be required for all in-warranty repairs.

4-6. Factory authorized service centers are also available for calibration and/or repair of instruments that are beyond their warranty period. Contact your nearest authorized Fluke Technical Service Center for a cost quotation. Ship the instrument and remittance in accordance with instructions received.

Table 4-1. List of Recommended Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
PREFERRED		
DMM Calibrator	John Fluke 5100A family	John Fluke Models 5100A, 5101A, 5102A
ALTERNATE		
AC Calibrator	Voltage Range: 0 to 750V ac Frequency Range: 100 to 450 Hz: ±0.25% Voltage Accuracy: 100 to 450 Hz: ±0.1%	John Fluke Models 5200A and 5215A
DC Calibrator	Voltage Range: 0 to 1000V dc Accuracy: ±0.025%	John Fluke Model 343A
DC Current Calibrator	Current Range: 2 mA to 2A Accuracy: ±0.2%	John Fluke Model 382A
Decade Resistor or Individual Resistors	Resistance Values: 190Ω, 1.9 kΩ, 19 kΩ, 190 kΩ, 1.9 MΩ, and 10 MΩ Accuracy: ±0.025% Power Rating: ⩾1/8 watt	ESI Model DB62

4-7. GENERAL INFORMATION

4-8. Access Information

NOTE

To avoid contaminating the pcb with oil from the fingers, handle it by the edges or wear gloves. If the pcb does become contaminated, refer to the cleaning procedure given later in this section.

4-9. BACKUP FUSE (F2) AND CALIBRATION ACCESS

4-10. Use the following procedure to access the 8020B calibration adjustments.

1. Set the power switch to OFF.
2. Disconnect test leads and battery eliminator, if attached.
3. Open the battery compartment and disconnect the battery.
4. Remove the three phillips-head screws from the bottom of the case.
5. Turn the instrument face-up and grasp the top cover at both sides of the input connectors. Then, pull the top cover from the unit.

6. Backup Fuse (F2) all adjustments necessary to complete the calibration procedure are now accessible (see Figure 4-1).

4-11. COMPONENT/PCB ACCESS

4-12. Use the following procedure to remove the Main PCB Assembly from the case:

1. Complete the calibration access procedure.

2. Remove the screw from shield.

3. Using your index finger, lift the lower right-hand corner of the pcb. When the pcb is freed, pull it to the right until it clears the shelf under the buttons, and then lift up. Handle the PCB by its edges to prevent surface contamination.

4. To reassemble the 8020B logically reverse this procedure.

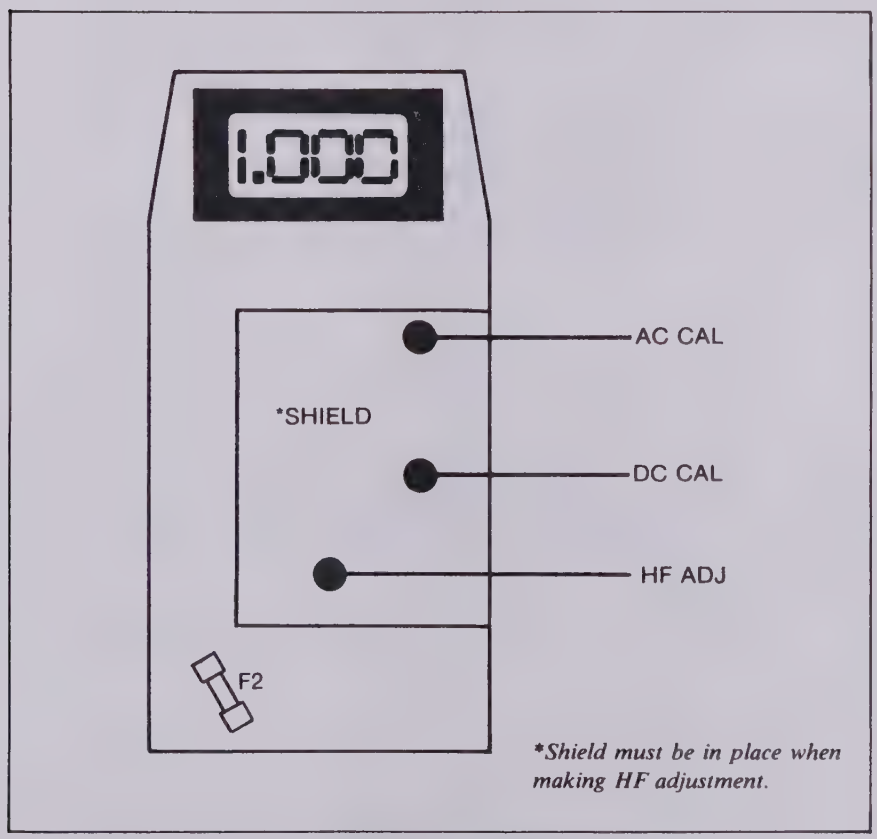


Figure 4-1. Calibration Adjustment Locations

NOTE

When installing the pcb, route the battery-clip wires behind the post on the left-hand side of the bottom case, and thread the battery-clip through the battery-cover opening. Also make sure that the removable plastic lip that resides beneath the range switch pushbuttons is properly installed in the bottom case. The green power switch cap should also be mounted on the power switch.

4-13. DISPLAY ACCESS

4-14. Refer to Figure 4-2 and the following procedure to remove/replace the LCD assembly.

1. Remove the Main PCB Assembly using the PCB access procedure.

2. Place your thumbs on either side of the display lens and carefully slide the lens out of the LCD bracket.

3. Turn the LCD bracket upside down, gently tap it against your palm. The LCD should fall out.

NOTE

When installing the LCD make certain that its flat surface is facing out and its connector pattern is on top of and makes contact with, the flexible layered connector. All of the parts indicated in figure 4-2 must be thoroughly cleaned and free of particles to assure proper display operation.

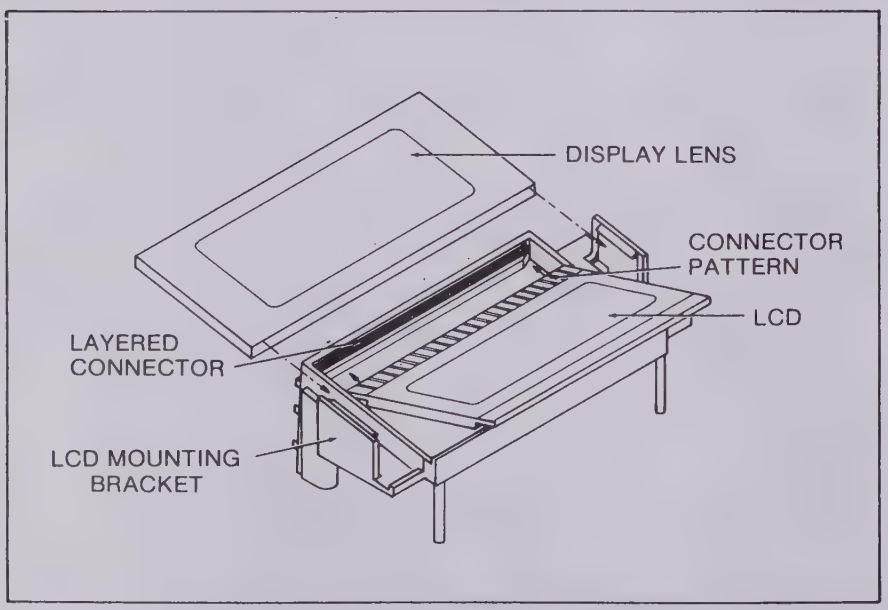


Figure 4-2. LCD Display Assembly

4-15. LSI (U1) ACCESS

4-16. Use the following procedure to remove/replace the A/D Converter and Display Driver IC, U1.

1. Remove the pcb assembly using the component/pcb access procedure.

2. On the bottom of the pcb locate and remove the two phillips-head screws from the display assembly.

3. Lift the display assembly from the pcb to expose U1.

CAUTION

U1 is a MOS device and is subject to damage by static discharge. Observe the precautions given later in this section under troubleshoooting before attempting to remove or replace U1.

4. Use a screw driver or a reasonable substitute to rock (by prying up on each end of the IC) the IC out of it socket.

5. When installing U1 make sure all pins are lined up in the socket, and then carefully press it into place.

4-17. Cleaning

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials used in the instrument.

CAUTION

Do not allow the liquid crystal display to get wet. Remove the Display Assembly before washing the pcb and do not install it until the pcb has been fully dried.

4-18. Clean the front panel and case with a mild solution of detergent and water. Clean dust from the circuit board with low pressure (<20 psi) dry air. Contaminates can be removed from the circuit board with demineralized water and a soft brush (remove the Display Assembly before washing, and avoid getting excessive amounts of water on the switches). Dry with clean, dry air at low pressure, and then bake at 50 to 60°C (124-140°F) for 24 hours.

4-19. Battery/Backup Fuse Replacement

WARNING

BATTERY/FUSE REPLACEMENT SHOULD ONLY BE PERFORMED AFTER THE TEST LEADS HAVE BEEN REMOVED FROM THE INPUT JACKS, AND THE POWER SWITCH IS SET TO OFF. BACKUP FUSE REPLACEMENT PROCEDURES MUST BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. USE ONLY THE RECOMMENDED FUSE TYPE FOR REPLACEMENT.

4-20. Refer to Section 1 of this manual for battery and main fuse (F1) replacement procedure. Use the following procedure to replace the backup fuse (F2).

1. Complete the Backup Fuse and Calibraion Access procedure located earlier in this section.

2. Using a pointed tool such as a probe tip, pry the backup fuse from its holder.

3. Replace the defective backup fuse with a 3A, 600V type BBS-3 only.

4-21. PERFORMANCE TEST

4-22. The performance test is used to compare the 8020B performance with the list of specifications given in Section 1 of this manual. It is recommended for incoming inspection, periodic maintenance, and to verify specifications. If the instrument fails any part of the test, calibration and/or repair is indicated.

4-23. Initial Procedure

4-24. Establish the following test conditions before continuing with the Performance Test:

1. Allow the unit to stabilize at an ambient temperature of 23 ±5°C (73 ±9°F).

2. Check and, if necessary, replaced the fuses and battery.

3. Set the power switch to ON.

4-25. Display Test

4-26. The following procedure is used to test the operation of all display digits and segments:

1. Select the Ω function and the 20 kΩ range. The display should be blanked with the exception of the overrange indicator (1) in the left hand column and a decimal point in the center of the display.

2. Connect a Decade Resistor between the V/Ω/S and COMMON input terminals.

3. Set the Decade Resistor to 10 kΩ and verify a display of 10.00 ±3 digits.

4. Sequentially increase the resistance in 1.11 kΩ steps and verify the operation of each digit and its segments.

5. Disconnect the Decade Resistor at the input terminals, and select the 2000 kΩ range. A decimal point should not be displayed.

6. Sequentially select the 200, 20 and 2 kΩ range. The decimal point should appear in the tenths, hundredths, and thousandths position, respectively.

4-27. Resistance/Conductance Test

4-28. The operation and accuracy of the resistance and conductance ranges are tested in the following procedure:

1. Connect the Decade Resistor between the V/Ω/S and COMMON input terminals.

2. Refer to Table 4-2, and select the range and input conditions specified in step 1. Verify that the display reading is within the limits shown.

3. Execute and verify steps 2 through 8 of Table 4-2, using the procedure described in step 2.

4-29. Continuity Test

4-30. Use the following procedure to verify proper operation of the continuity function:

1. Select the Ω function and 2 kΩ range.

2. Connect the test leads to the COMMON and V/Ω terminals.

3. Depress the AC/DC switch to activate the audible tone.

4. Momentarily short the test leads together and observe that the tone sounds.

WARNING

THE LOCAL LINE VOLTAGE IS USED IN THE FOLLOWING STEP. BE CAREFUL NOT TO TOUCH THE PROBE TIPS WITH YOUR FINGERS OR TO ALLOW THE 120V ACRECEPTACLE TO BECOME SHORTED.

Table 4-2. Resistance/Conductance Check

STEP	RANGE	DECADE RESISTOR		JOHN FLUKE 5100A/5101A/5102A	
		INPUT RESISTANCE	DISPLAY READING	INPUT RESISTANCE	DISPLAY READINGS
1	200Ω	Short	00.0 to 00.2	Short	00.0 to 00.2
2	2 kΩ	Short	0.000 to 0.001	Short	.000 to 0.001
3	200Ω	190Ω	189.3 to 190.7	100Ω	99.5 to 100.5
4	2 kΩ	1.9 kΩ	1.897 to 1.903	1 kΩ	.998 to 1.002
5	20 kΩ	19 kΩ	18.97 to 19.03	10 kΩ	9.98 to 10.02
6	200 kΩ	190 kΩ	189.7 to 190.3	100 kΩ	99.8 to 100.2
7	2000 kΩ	1900 kΩ	1861 to 1939	1000 kΩ	980 to 1020
8	20 MΩ	10 MΩ	9.80 to 10.20	10 MΩ	9.80 to 10.20
9	200 nS	10 MΩ	97.0 to 103.0	10 MΩ	97.0 to 103.0
10	200 nS	Open	01.0 to 00.0	Open	01.0 to 00.0

5. At a convenient 120V ac receptacle, insert the test leads as if to measure the line voltage. A series of beeps at a rate of approximately 5 to 10 per second indicates proper operation of the pulse stretcher circuit.

4-31. DC Voltage Test

4-32. Use the following procedure to check the accuracy and overall operation of the dc voltage ranges:

WARNING

CONNECT THE GROUND/COMMON/LOW SIDE OF THE VOLTAGE CALIBRATOR TO COMMON ON THE 8020B.

1. Set the DC Calibrator for a zero volt output.

2. Connect the DC Calibrator output to the V/Ω/S and COMMON input terminals of the 8020B (calibrator ground/common/low to 8020B COMMON.

3. With reference to Table 4-3, select the 8020B voltage range given in step 1, and set the DC Calibrator output to the corresponding 8020B input voltage. Verify that the display reading is within the limits shown.

4. Execute and verify steps 2 through 7 of Table 4-3, using the procedure described in step 3.

4-33. AC Voltage Test

4-34. The ac voltage ranges are checked for accuracy and operation using the following procedure:

WARNING

CONNECT THE GROUND/COMMON/LOW SIDE OF THE AC CALIBRATOR TO COMMON ON THE MODEL 8020B.

1. Set the AC Calibrator for a zero volt ac output.

Table 4-3. DC Voltage Checks

STEP	VOLTAGE RANGE	INPUT VOLTAGE, DC	DISPLAY READING
1	200 mV	+190.0 mV	189.7 to 190.3
2	200 mV	-190.0 mV	-189.7 to -190.3
3	2V	0.0V	-.001 to .001
4	2V	+1.9V	1.897 to 1.903
5	20V	+19V	18.97 to 19.03
6	200V	+190V	189.7 to 190.3
7	1000V	+1000V	998 to 1002

2. Connect the AC Calibrator output to the V/Ω/S and COMMON input terminals for the 8020B (calibrator ground/common/low to 8020B COMMON).

3. With reference to Table 4-4, select the 8020B voltage range given in step 1, and set the AC Calibrator output to the corresponding 8020B input voltage and frequency. Verify that the display reading is within the limits shown.

4. Execute and verify steps 2 through 12 of Table 4-4, using the procedure described in step 3.

4-35. DC Current Test

4-36. The following procedure is used to check the operation and accuracy of the dc current ranges.

1. Set the output of the DC Current Calibrator to zero mA.

2. Connect the output of the DC Current Calibrator to the (A) and COMMON input terminals on the 8020B.

Table 4-4. AC Voltage Test

STEP	VOLTAGE RANGE	INPUT		DISPLAY READING	
		VOLTAGE	FREQ.		
1	200 mV	Short	-	00.0 to 00.2	
2	200 mV	190 mV	100 Hz	188.4 to 191.6	
3	200 mV	19 mV	100 Hz	18.7 to 19.3	
4	200 mV	190 mV	5 kHz	180.0 to 199.9	
5	2V	1.9V	5 kHz	1.800 to 1.999	
6	2V	1.9V	100 Hz	1.884 to 1.916	
7	20V	19V	100 Hz	18.84 to 19.16	
8	20V	19V	5 kHz	18.00 to 19.99	
9	200V	100V	2 kHz	98.2 to 101.8	
10	200V	190V	100 Hz	188.4 to 191.6	
11	750V	750V	100 Hz	741 to 759	*
12	NO TEST				
9	200V	190V	2 kHz	186.9 to 193.1	
10	200V	190V	100 Hz	188.4 to 191.6	
11	750V	750V	100 Hz	741 to 759	**
12	750V	750V	1 kHz	741 to 759	

*Perform if using John Fluke 5100A/5101A/5102A.
**Perform if using alternate equipment listed in Table 4-1.

3. With reference to Table 4-5, select the 8020B current range indicated in step 1, and set the calibrator output to provide the corresponding 8020B input current. Verify that the display reading is within the limits shown.

4. Execute and verify steps 2 through 4 of Table 4-5, using the procedure described in step 3.

4-37. CALIBRATION

4-38. Under normal operating conditions, the 8020B should be calibrated once every two years to maintain the specifications given in Section 1 of this manual. If instrument repairs have been made or if the unit fails the performance test, immediate calibration is indicated. Equipment required for calibration is given in Table 4-1. If the necessary equipment is not available, your nearest authorized Fluke Technical Service Center will be happy to help. A list of these service centers, as well as shipping information, is given at the back of this manual.

4-39. Use the following procedure to calibrate the 8020B.

NOTE

This procedure assumes an ambient temperature of 23 ±2° C (70 to 77° F) and a relative humidity of less than 80%. The temperature of the unit should be allowed to stabilize for at least 30 minutes before calibration begins.

1. Remove the top cover from the 8020B using the access procedure given earlier in this section.

2. Set the 8020B power switch to ON and select the 200 mV DC range.

3. Set the output of the DC Calibrator to +190.0 mV and connect it to the 8020B input terminals; + to V/Ω/S, and - to COMMON.

4. Adjust the DC CAL pot (R5), as shown in Figure 4-1, for a display of 190.0 or 190.1. (Use a plastic adjustment tool or a plastic screw driver for all adjustments.)

5. Disconnect the DC Calibrator from the 8020B input terminals.

6. Select the 200 mV AC range on the 8020B.

Table 4-5. DC Current (mA) Checks

STEP	CURRENT RANGE	INPUT CURRENT, DC	DISPLAY READING
1	2 mA	+1.9 mA	1.885 to 1.915
2	20 mA	-19 mA	-18.85 to -19.15
3	200 mA	+190 mA	188.5 to 191.5
4	2000 mA	+1900 mA	1885 to 1915

7. Set the output of the AC Calibrator to 190 mV at 100 Hz, and connect it to the 8020B input terminals; V/Ω/S and COMMON.

8. Adjust the AC CAL pot (R9) for a display of 190.0 (an occasional flash of ±1 digit is acceptable).

9. Select the 2V ac range on the 8020B and set the AC Calibrator output to 1.9V at 5 kHz.

10. Adjust the HF ADJ (C1) for a display of 1.895 to 1.905.

11. Execute the performance test given earlier to ensure that all fixed range resistors and other non-adjustable components are operating within their specified limits.

4-40. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 8020B.

4-41. When troubleshooting or repairing the 8020B use the precautions listed on the Static Awareness sheet to prevent damage from static discharge. Never remove, install or otherwise connect or disconnect components without first setting the 8020B power switch to OFF.

4-42. A troubleshooting guide for the 8020B is given in Table 4-6. To properly use the guide complete the performance test given earlier in this section and note any discrepancies. Then locate the heading of the procedure in question in the Test and Symptom column (Table 4-6). Under that heading isolate the symptom that approximates the observed malfunction. Possible causes are listed to the right of the selected symptom. Details necessary to isolate a particular cause can be derived from the theory of operation in Section 3 and the schematic diagram in Section 7.

Table 4-6. Troubleshooting Guide

TEST AND SYMPTOM	POSSIBLE CAUSE
INITIAL PROCEDURE	
BT is displayed when unit is turned on.	Low battery, Q3, U2, U1. (See also operating note for A81 accessory.)
Display blank.	Dead battery, power switch, VR2 shorted, U1, battery connector.

Table 4-6. Troubleshooting Guide (cont)

TEST AND SYMPTOM	POSSIBLE CAUSE
DISPLAY TEST	
One or more segments will not light through entire test.	Display interconnect, display, or A/D Converter U1.
Decade inoperative or one or more segments always lit.	U1.
Improper decimal point indication.	Range switches, Z6, U2, or display. (Check signals at U2 to isolate.)
Minus sign improperly displayed.	U1.
Display lit but does not respond to changes in input.	Reference VR1, crystal Y1, A/D Converter U1.
RESISTANCE/CONDUCTANCE TEST	
Displayed reading is out of tolerance on at least one but not all ranges.	Range resistor Z1.
Readings are noisy on all ranges.	Thermistor RT1, R2 open.
Readings are out of tolerance on high ohms.	RJ1, RJ2, RJ3, RJ4 damaged from severe overload.
Residual reading with test leads open	PCB is contaminated (see cleaning procedure, Section 4.)
DC VOLTAGE TEST	
Display reading is out of tolerance on 200 mV range.	Out of calibration (DC), Vref (VR1) in error, Z2, U1, S1.
Only 200 mV range works - other ranges read 000.	R2 - fusible resistor open.
Readings are out of tolerance on all ranges except 200 mV.	Range resistor Z1, Z3, Z4.

Table 4-6. Troubleshooting Guide (cont)

TEST AND SYMPTOM	POSSIBLE CAUSE
AC VOLTAGE TEST	
Displayed reading is out of tolerance on 200 mV range.	Out of calibration (AC), AC converter defective, AR1.
Only 200 mV range works - other ranges read 000.	R2 - fusible resistor open.
2V range is out of tolerance with 1.9V, 5 kHz input.	HF adjust (C1) out of calibration.
Readings are out of tolerance on all ranges except 200 mV.	Z1, Z3, Z4, AR1.
DC CURRENT TEST	
Input does not affect display.	Fuse F1 and/or F2 open, CR1, CR2.
Displayed reading is out of tolerance on one or more ranges.	If 2000 mA and 200 mA ranges are okay, Z3 is defective. Otherwise Z4 is defective.
CONTINUITY TEST	
Tone doesn't sound when test leads are shorted.	S1G, S8B, AR20, U20, LS1, Board interconnection, defective test lead, test lead in mA jack.
CALIBRATION	
DC CAL pot at limit.	VR1, Z2, or R5.
AC CAL pot at limit.	Z5, CR3, CR4, R9, AR1, dc calibration incorrect.
HF adjust at limit.	S3D, Z1, C2, shield not installed.

Section 5
List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufacturers. (See Table 5-4 for Code-to-Name list.)

5. Manufacturer's Part Number.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity
2. FLUKE Stock Number
3. Description
4. Reference Designation
5. Printed Circuit Board Part Number
6. Instrument Model and Serial Number

CAUTION

Indicated devices are subject to damage by static discharge.

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
	8020B, FINAL ASSEMBLY FIGURE 5-1(8020B-T/B)	8020B	89536	8020B			
A1Ⓐ	MAIN PCB ASSY				1		1
A2Ⓐ	ANNUNCIATOR PCB ASSY	613943	89536	613943	1		1
BT1	BATTERY, PRIMARY TYPE 1604, 9V	446823	89536	446823	1		
F1	FUSE, FAST ACTING, 2A	376582	71400	AGX-2	2	5	2
F2	FUSE, FAST ACTING, 3A	475004	71400	BBS-3	1	5	
H1	SCREW, PHP, 4-40 X 3/16	129882	89536	129882	1		
H2	SCREW, PHP, 3/4 HI-LO, THD/FORM	447953	89536	447953	3		
H3	SCREW, PHP, 3/8 HI-LO, THD/FORM	448456	89536	448456	2		
MP1	BAIL, FOOT	616961	89536	616961	1		
MP2	BRACKET, LCD MOUNTING	531657	89536	531657	1		
MP3	BUTTON, FUNCTION SWITCH (S1, S8)	606889	89536	606889	2		
MP4	BUTTON, POWER SWITCH	456491	89536	456491	1		
MP5	BUTTON, RANGE SWITCH (S2 - S7)	606871	89536	606871	6		
MP6	CASE, BOTTOM	613950	89536	613950	1		
MP7	CASE, TOP	542027	89536	542027	1		
MP8	COVER, BATTERY	613968	89536	613968	1		
MP9	DECAL, CASE TOP	604405	89536	604405	1		
MP11	FLANGE, SWITCH	455881	89536	455881	1		
MP12	FOOT, NON-SKID	604397	89536	604397	4		
MP13	LENS, DISPLAY	606848	89536	606848	1		

Table 5-1. 8020B Final Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
MP14	PLATE, LCD BRACKET	531665	89536	531665	1		
MP15	SHIELD	604389	89536	604389	1		
MP16	SHOCK ABSORBER	428441	89536	428441	1		
MP17	SPACER, CASE	458588	89536	458588	2		
MP18	TEST LEADS AND PROBE	516666	89536	516666	1		
MP19	CONNECTOR, ELASTOMERIC	520858	89536	520858	1		
TM1	8020B MANUAL (NOT SHOWN)	616029	89536	616029			
TM2	8020B OPERATOR GUIDE (NOT SHOWN)	616730	89536	616730			
U3	LIQUID CRYSTAL DISPLAY	504324	89536	~~504324~~ 613398 as of 3-3-84 JM	1		
	RECOMMENDED SPARE PARTS KIT, 8020B	653378	89536	653378			
	1 REPLACE AT COMPONENT LEVEL ONLY						
	2 F1 FUSE, EUROPEAN USAGE: FUSE, 5 X 20 MM, 2A, 250V	460972	75915	212002	2	5	

1026058-0932

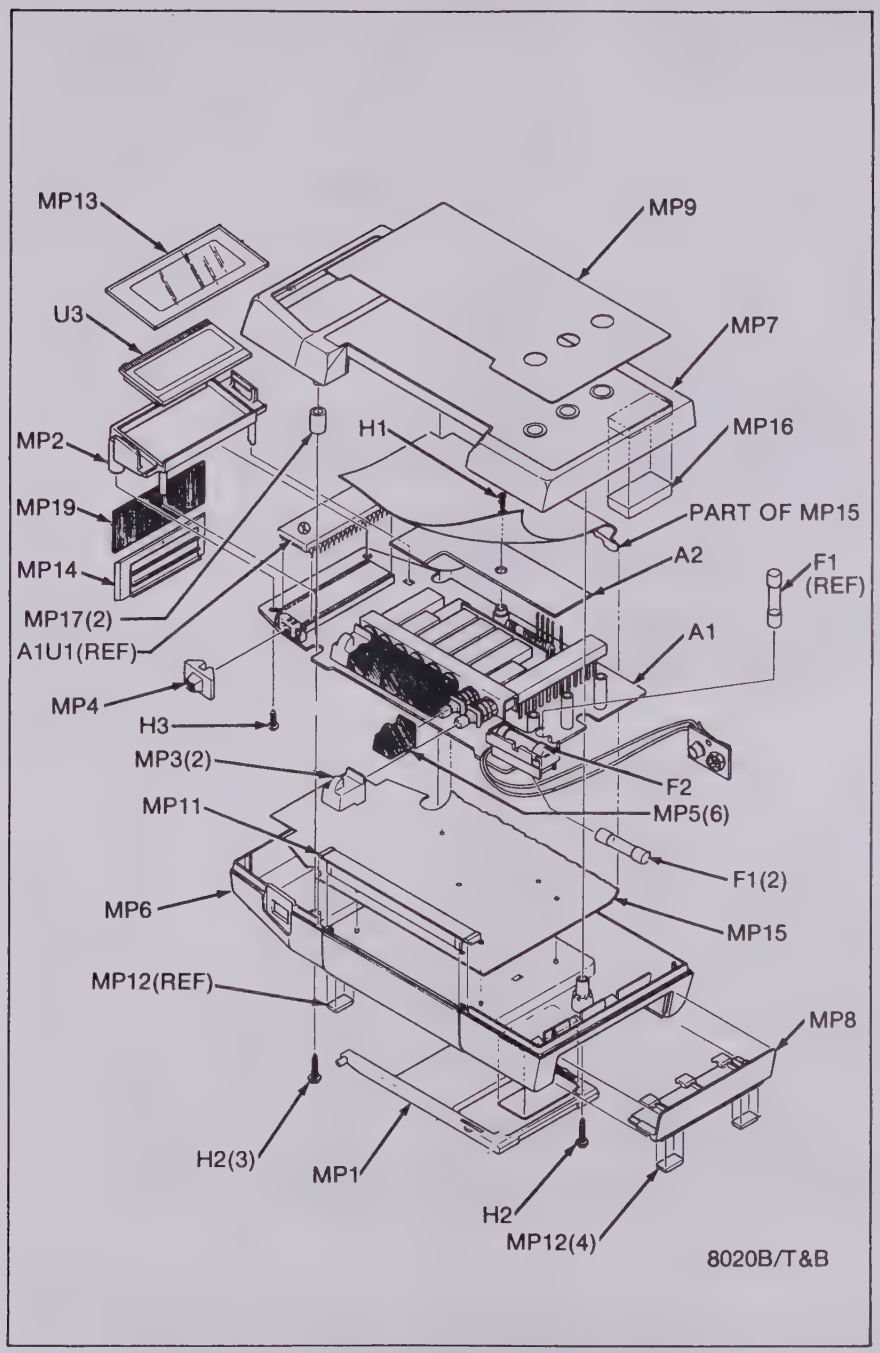


Figure 5-1. 8020B Final Assembly

Table 5-2. A1 Main PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A1Ⓧ	MAIN PCB ASSEMBLY FIGURE 5-2 (8020B-4001)						1
AR1	IC, LINEAR, OP-AMP	418566	89536	418566	1	1	
C1	CAP, CER, 500 PF +/-10%, 1000V	105692	71590	2DDH60N501K	2		
C2	CAP, VAR, 0.25 - 1.5 PF, 2000V	218206	72982	530.000	1		
C3	CAP, ELECT, 22 UF +/-20%, 6.3V	614016	89536	614016	1		2
C3	CAP, ELECT, 22 UF +/-20%, 16V	614750	89536	614750			
C4	CAP, POLYPROP, 0.047 UF +/-10%, 100V	446773	89536	446773	2		
C5	CAP, POLYPROP, 0.10 UF +/-10%, 100V	446781	89536	446781	1		
C6	CAP, MYLAR, 0.22 UF +/-10%, 100V	436113	73445	C280MAH/A220K	1		
C7	CAP, POLYPROP, 0.047 UF +/-10%, 100V	446773	89536	446773	REF		
C8	CAP, POLYESTER, 0.022 UF +/-10%, 1000V	448183	52763	MKT. 1822 322/10	1		
C9	CAP, ELECT, 15 UF +/-20%, 35V	614024	89536	614024	1		2
C9	CAP, ELECT, 22 UF +/-20%, 16V	614750	89536	614750	REF		
C10	CAP, CER, 27 PF +/-2%, 100V	362749	89536	362749	1		
C11	CAP, CER, 0.22 UF +/-20%, 50V	519157	51406	RPE111Z5U224M50V	1		
C12	CAP, CER, 500 PF +/-10%, 1000V	105692	71590	2DDH60N501K	REF		
CR1	DIODE, SI, RECTIFIER	347559	14099	3SM05	2	1	
CR2	DIODE, SI, RECTIFIER	347559	05277	1N5400	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	4	1	
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5,CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
J4	CONNECTOR, DC POWER	423897	89536	423897	1		
J5	JACK, DC POWER, PC MOUNT	535278	89536	535278	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
MP1	FUSE SPRING (F2)	535211	89536	535211	1		
MP2	FUSE CAP (F2)	540716	89536	540716	1		
MP3	FUSE CLIP (F2)	535203	89536	535203	1		
MP4	FUSE CLIP (F2)	534925	89536	534925	1		
P1-P5	POST, CONNECTOR	603910	89536	603910	5		
Q1	TRANSISTOR, SI, NPN	218396	04713	2N3904	3		
Q2	TRANSISTOR, SI, NPN	218396	04713	2N3904	REF		
Q3	TRANSISTOR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, COMP, 100K +/-10%, 1W	109397	01121	GB1041	1		
R2	RES, WW, 1K +/-10%, 2W	474080	89536	474080	1		
R3	RES, DEP. CAR, 200K +/-5%, 1/4W	441485	80031	CR251-4-5P200K	1		
R4	RES, DEP. CAR, 220K +/-5%, 1/4W	348953	80031	CR251-4-5P220K	1		
R5	RES, VAR, 500 +/-20%, 0.3W	603746	51406	RVS0707-V-100-3-501M	1		
R6	RES, COMP, 1M +/-10%, 1W	109793	01121	GB1051	1		
R7	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	1		
R8	RES, DEP. CAR, 2.2M +/-5%, 1/4W	342659	80031	CR251-4-5P2M2	1		
R9	RES, VAR, 300 +/-20%, 0.3W	614040	51406	RVS0707-V-100-3-301M	1		
R10	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
RJ1	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	4	1	
RJ2	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
RJ3	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
RJ4	VARISTOR, 430V +/-10%	447672	09214	V150LAX827	REF		
RT1	THERMISTOR	446849	50157	180Q10200	1		
S1-S8	SWITCH ASSEMBLY, PUSHBUTTON	453647	89536	453647	1		
S9	SWITCH, SLIDE, SPDT, 125V	453365	79727	G1-116-0001 G20-52	1	1	

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
U1Ⓧ	IC, C-MOS, A-D CONV	429100	89536	429100	1	1	
U2Ⓧ	IC, C-MOS, QUAD EXCLUSIVE-OR GATE	355222	18736	CD4030AE	1	1	
VR1	IC, LINEAR, LO-VOLT REF (SELECTED)	508259	89536	508259	1		
VR2	DIODE, ZENER, 12V	113456	04713	1N963A	1		
XU1	SOCKET, IC, 40-PIN	429282	09922	DILB40P-108	1		
Y1	CRYSTAL, 3.2 MHZ	513937	89536	513937	1	1	
Z1	RESISTOR NETWORK	513655	89536	513655	1	1	
Z2	RESISTOR NETWORK	447680	89536	447680	1	1	
Z3	RESISTOR NETWORK	447706	89536	447706	1	1	
Z4	RESISTOR NETWORK	435727	89536	435727	1	1	
Z5	RESISTOR NETWORK	447698	89536	447698	1	1	
Z6	RESISTOR NETWORK	447714	89536	447714	1	1	

1 REPLACE AT COMPONENT LEVEL ONLY

2 C3, C9: EITHER VALUE MAY BE INSTALLED ON THIS ASSEMBLY

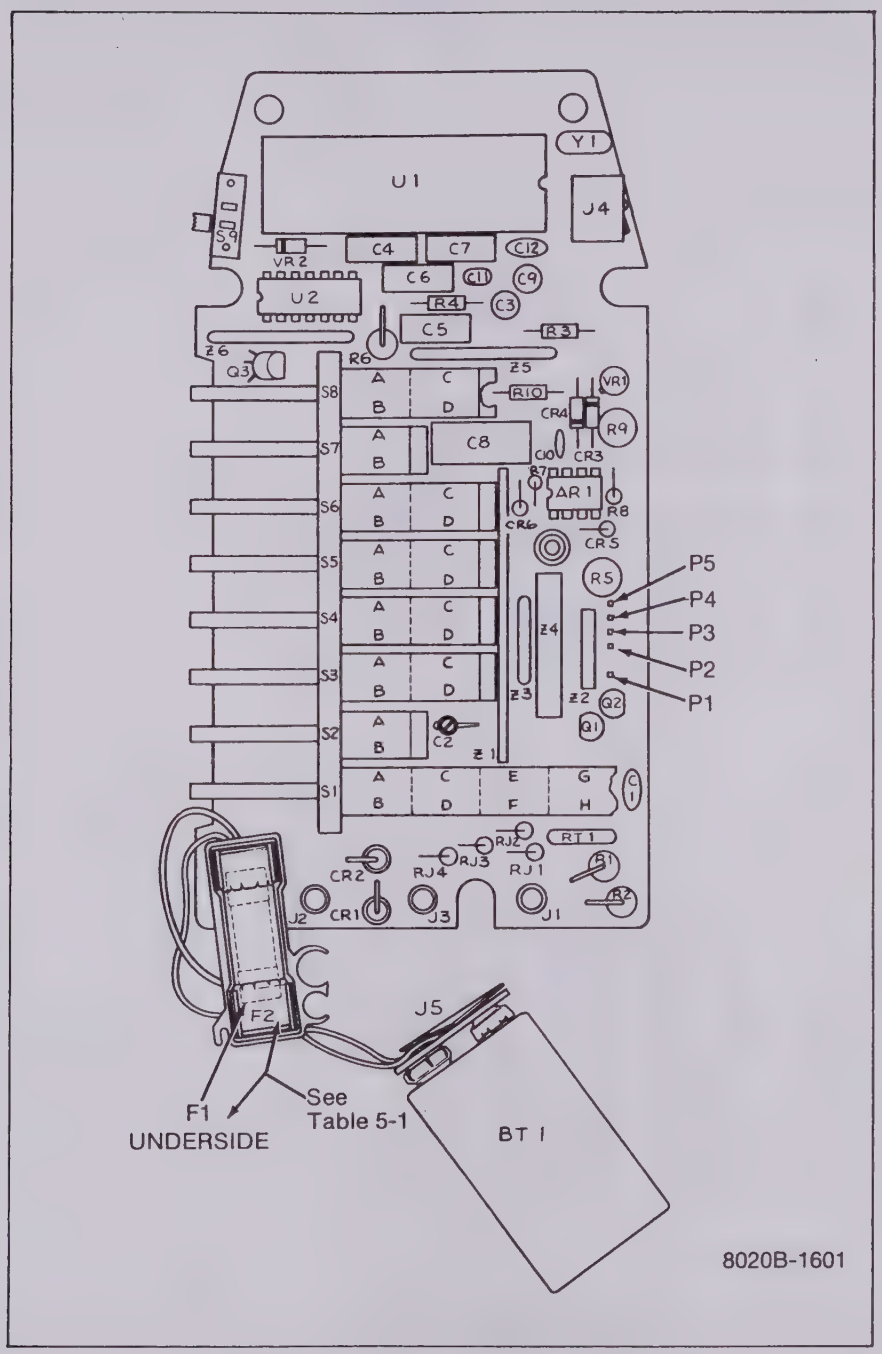


Figure 5-2. A1 Main PCB Assembly

Table 5-3. A2 Annunciator PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A2Ⓧ	ANNUNCIATOR PCB ASSY FIGURE 5-3 (8020B-4002T)	613943	89536	613943	REF		1
AR20	IC, DUAL OP AMP	604363	89536	604363	1	1	
C20	CAP, CER, .22 UF +/-20%, 50V	519157	51404	RPE111Z5U224M50V	1		
C21	CAP, CER, 150 PF	614032	89536	614032	1		
J20	RECEPTACLE, SINGLE	614396	22526	75377-001	1		
J21	SOCKET, 4-PIN	417311	30035	SS-109-1-04	1		
LS1	XDUCER, AUDIO, 12,000PF	602490	51406	EFB-RD24C01	1		
R21	RES, DEP. CAR, 200K +/-5%, 1/4W	441485	80031	CR251-4-5P-200K	4		
R22	RES, DEP. CAR, 18K +/-5%, 1/4W	348862	80031	CR251-4-5P18K	1		
R23	RES, DEP. CAR, 200K +/-5%, 1/4W	441485	80031	CR251-4-5P-200K	REF		
R24	RES, COMP, 100K +/-5%, 1/4W	348920	01121	CB1045	1		
R25	RES, DEP. CAR, 200K +/-5%, 1/4W	441485	80031	CR251-4-5P-200K	REF		
R26	RES, DEP. CAR, 200K +/-5%, 1/4W	441485	80031	CR251-4-5P-200K	REF		
R27	RES, COMP, 10M +/-5%, 1/4W	194944	01121	CB1065	1		
R28	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	1		
U20Ⓧ	IC, C-MOS, QUAD 2-INPUT NAND GATE	418509	12040	MM74C00N	1	1	

1 REPLACE AT COMPONENT LEVEL ONLY

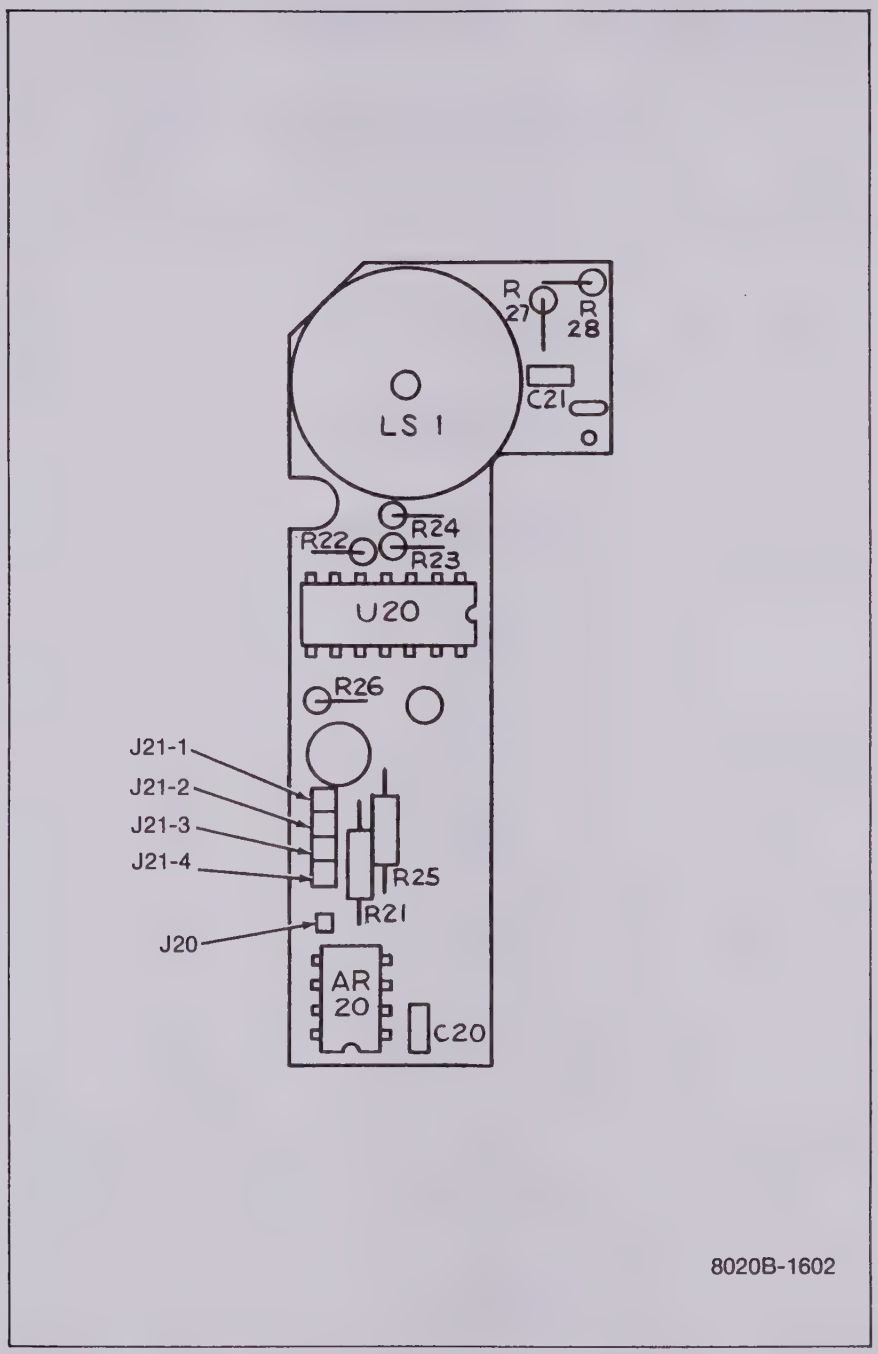


Figure 5-3. A2 Annunciator PCB Assembly

Table 5-4. Federal Supply Codes for Manufacturers

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

02735
Replaces 18725
RCA - Solid State Div.
Somerville, New Jersey

04713
Motorola Inc.
Semiconductor Group
Phoenix, Arizona

05277
Westinghouse Electric Corp.
Semiconductor Division
Youngwood, Pennsylvania

07263
Fairchild Camera & Instrument Corp.
Semiconductor Division
Mountain View, California

07910
Replaced by 15818

09214
General Electric Co.
Semiconductor Products
Power Component Operation
Auburn, New York

09922
Burndy Corp.
Norwalk, Connecticut

12040
National Semiconductor Corp.
Danbury, Connecticut

14099
Semtech Corp.
Newbury Park, California

15818
Teledyne Semiconductors
Formerly Amelco Semiconductor
Mountain View, California

18736
Voltronics Corp.
Hanover, New Jersey

19647
Caddock Electronics Inc.
Riverside, California

22526
DuPont, El DeNemours & Co. Inc.
Berg Electronics Div.
New Cumberland, Pennsylvania

30035
Jol Industries Inc.
Garden Grove, California

50157
Midwest Components Inc.
Muskegon, Mississippi

51404
Corning Glass Works
Medical & Scientific Instruments
Medfield, Maryland

51406
Murata Corporation of America
Marietta, Georgia

52763
Stettner-Trush Inc.
Cazenovia, New York

56289
Sprague Electric Co.
North Adams, Massachusetts

71400
Bussman Manufacturing
Div. of McGraw-Edison Co.
St. Louis, Missouri

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

72136
Electro Motive Mfg. Co.
Florence, South Carolina

72982
Erie Technical Products Inc.
Erie, Pennsylvania

73445
Amperex Electronic Corp.
Hicksville, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

Table 5-4. Federal Supply Codes for Manufacturers (cont)

79727 C - W Industries Warminster, Pennsylvania	84411 TRW Electronic Components TRW Capacitors Ogallala, Nebraska
80031 Mepco/Electra Corp. Morristown, New Jersey	89536 John Fluke Manufacturing Co., Inc. Everett, Washington

Section 6
Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the accessories available for use with the Model 8020B Digital Multimeter. Each accessory, as shown in Figure 6-1, is described in general terms under a separate major heading containing the accessory model number. The depth of detail is intended to give the prospective user an adequate first acquaintance with the features and capabilities of each accessory. Additional information, when necessary, is supplied with the accessory.

6-3. DELUXE CARRYING CASE (C90)

6-4. The C90 Deluxe Carrying Case is a pliable, vinyl, zipper-closed pouch that provides in-field-transport protection for the 8020B as well as convenient storage locations for test leads, operator guide and other small accessories. A finger- or belt-loop is included on the case as a carrying convenience.

6-5. TEMPERATURE PROBES (80T-150C and 80T-150F)

6-6. Introduction

6-7. The 80T-150 Temperature Probe converts the instrument into a direct-reading (1 mV dc/°) °C (80T-150C) or °F (80T-150F) thermometer. It is ideally suited for surface, ambient, and liquid measurements and lends itself easily to a wide range of design, troubleshooting, and evaluation applications. A rugged, fast-responding probe-tip with a 350V dc standoff makes the 80T-150 one of the most versatile and easy-to-use temperature probes available.

6-8. Specifications

RANGE (°C/°F) (field selectable by internal jumpers)	-50°C to +150°C or -58°F to 302°F
ACCURACY	±1°C (1.8°F) from 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C
RESOLUTION	0.1°C on 200 mV range
VOLTAGE STANDOFF	350V dc or peak ac
POWER	Internal disposable battery; 1,000 hours of continuous use

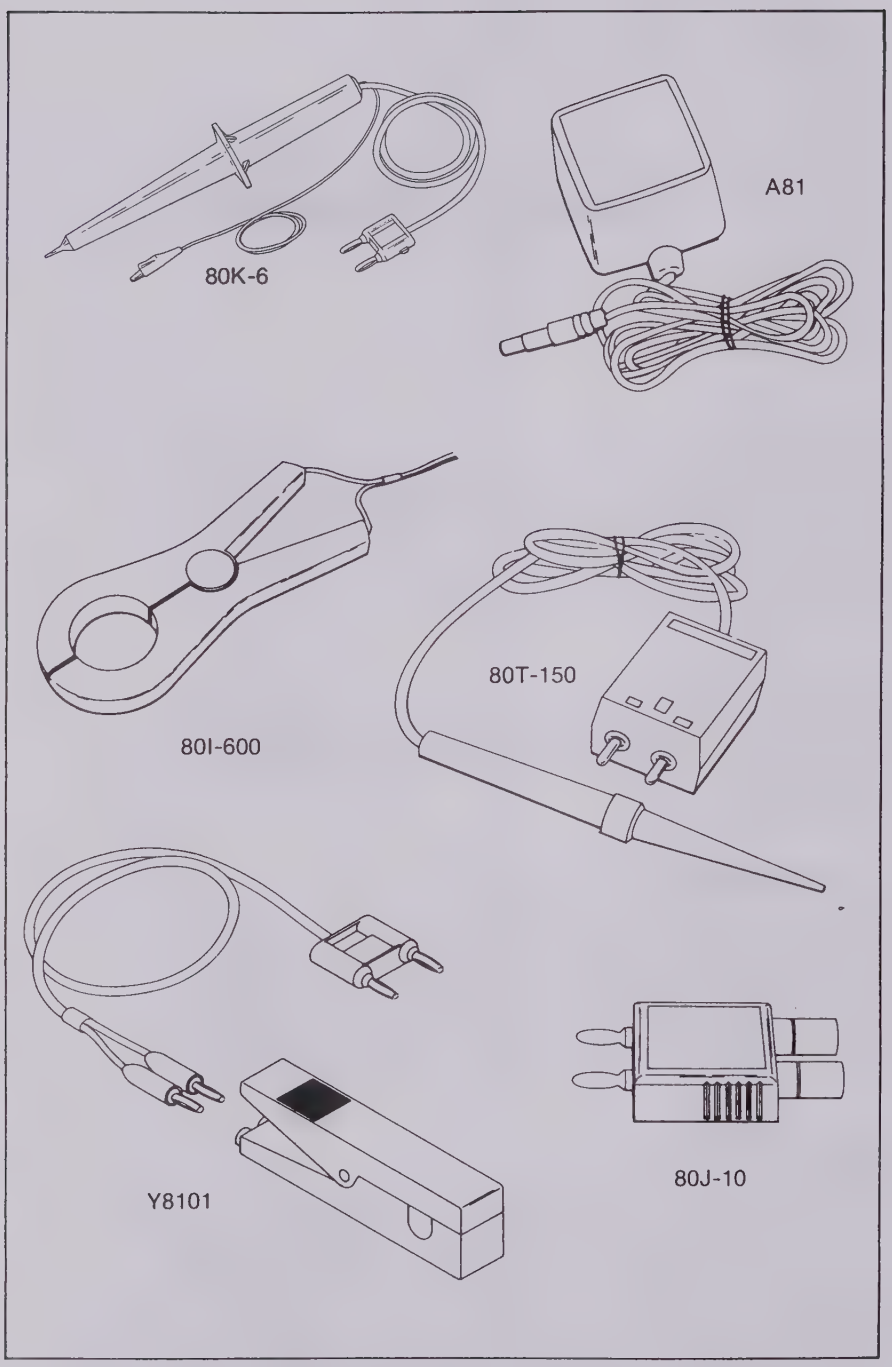


Figure 6-1. 8020B Accessories

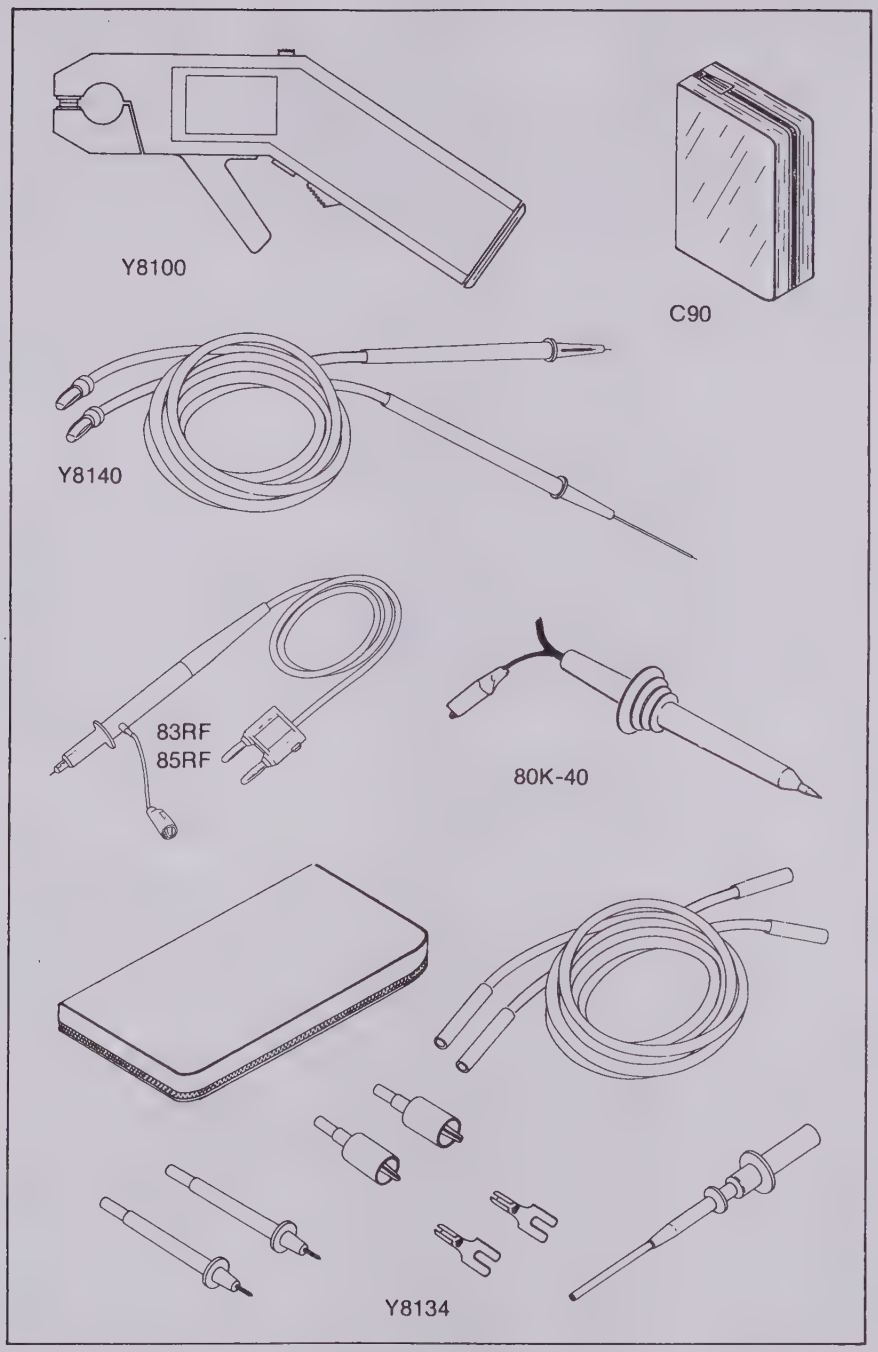


Figure 6-1. 8020B Accessories (cont)

6-9. CURRENT TRANSFORMER (80I-600)

6-10. Introduction

6-11. The Model 80I-600 extends the maximum 2A ac current measuring capability of the instrument up to a maximum of 600 amps. A clamp-on transformer designed into the probe allows measurements to be made without breaking the circuit under test. In use, the current carrying conductor being measured serves as the transformer's primary, while the 80I-600 serves as the secondary. Because of a high efficiency, quadrature type of winding, wire size and location of the conductor within the transformer jaws do not affect the accuracy of the current measurement.

6-12. Specifications

RANGE	1 to 600A ac
ACCURACY	±3%
FREQUENCY RESPONSE	30 Hz to 1 kHz, 10 kHz typical
DIVISION RATIO	1000:1
INSULATION	5 kV
MAXIMUM CONDUCTOR SIZE	2-inch diameter

6-13. HIGH VOLTAGE PROBE (80K-6)

6-14. Introduction

6-15. The 80K-6 is a high voltage probe designed to extend the voltage measuring capability of an ac dc voltmeter to 6000 volts. A 1000:1 voltage divider provides the probe with a high input impedance. The divider also provides high accuracy when used with a voltmeter having a 10 megohm input impedance. A molded plastic body houses the divider and protects the user from the voltage being measured.

6-16. Specifications

VOLTAGE RANGE	0 to 6 kV, dc or peak ac
INPUT IMPEDANCE	75 megohms nominal
DIVISION RATIO	1000:1
ACCURACY	
DC to 500 Hz	±1%
500 Hz to 1 kHz	±2%
Above 1 kHz	Output reading falls. Typically, -30% at 10 kHz.

6-17. HIGH VOLTAGE PROBE (80K-40)

6-18. Introduction

6-19. The Model 80K-40 extends the voltage measurement capability of the instrument up to 40 kV. Internally, the probe contains a special 1000:1 resistive divider. Metal-film resistors with matched temperature coefficients comprise the divider, and provide the probe with its excellent accuracy and stability characteristics. Also, an unusually high input impedance (1000 MΩ) minimizes circuit loading, and thereby contributes to measurement accuracy.

6-20. Specifications

VOLTAGE RANGE	1 kV to 40 kV dc or peak ac, 28 kV rms ac
INPUT RESISTANCE	1000 MΩ
DIVISION RATIO	1000:1
ACCURACY DC (OVERALL)	20 kV to 30 kV ±2% (calibrated at 25 kV)
UPPER LIMIT	Changes linearly from 2% at 30 kV to 4% at 40 kV

LOWER LIMIT .....Changes linearly from 2% at 20 kV to 4% at 1 kV
ACCURACY AC (OVERALL) .....±5% at 60 Hz

6-21. HIGH FREQUENCY PROBE (83RF)

6-22. Introduction

6-23. The 83RF Probe extends the frequency range of the DMMs voltage measurement capability to include 100 kHz to 100 MHz inputs from 0.25 to 30V rms. The probe operates in conjunction with the 8020B dc voltage ranges, and provides a dc output that is calibrated to be equivalent to the rms value of a sinewave input.

6-24. Specifications

FREQUENCY RESPONSE ..... ±1 dB from 100 kHz to 100 MHz (relative to ac/dc transfer ratio)

AC-TO-DC TRANSFER RATIO (23 ±5°C) .....

RMS Input (100 kHz)	DC Output
0.25 - 0.5V	0.25 - 0.5V ±1.5 dB
0.5 - 2.0V	0.5 - 2.0V ±0.5 dB
2.0 - 30V	2.0 - 30V ±1.0 dB

EXTENDED FREQUENCY RESPONSE ..... Useful for relative readings from 20 kHz to 250 MHz.
RESPONSE ..... Responds to peak value of input; calibrated to read the rms value of a sine wave.
VOLTAGE RANGE ..... 0.25 to 30V dc
MAXIMUM DC INPUT ..... 200V dc
TEMPERATURE COEFFICIENT (0 to 18°C, 28 to 50°F) ..... ±0.1 of ac-to-dc transfer ratio specifications per °C
INPUT CAPACITANCE ..... <5 pF

6-25. HIGH FREQUENCY PROBE (85RF)

6-26. Introduction

6-27. The Model 85RF High Frequency Probe allows measurements over a frequency range of 100 kHz to 500 MHz from .25V to 30V rms. It operates in conjunction with the instruments dc voltage ranges and provides a dc output that is calibrated to be equivalent to the rms value of a sinewave input.

6-28. Specifications

FREQUENCY RESPONSE
100 kHz to 100 MHz ..... ±0.5 dB
100 MHz to 200 MHz ..... ±1.0 dB
200 MHz to 500 MHz ..... ±3.0 dB
EXTENDED FREQUENCY RESPONSE ..... Useful for relative readings from 20 kHz to 700 MHz.
RESPONSE ..... Responds to peak value of input; calibrated to read rms value of a sine wave.
VOLTAGE RANGE ..... 0.25V dc to 30V rms

MAXIMUM DC INPUT ..... 200V dc
INPUT CAPACITANCE ..... <5 pF
AC-TO-DC TRANSFER RATIO . 1:1
RATIO ACCURACY ..... 0.5 dB at 10 MHz

6-29. BATTERY ELIMINATOR (A81-115)

6-30. The A81 Battery Eliminator converts the 8020B from battery to ac-line operation. It is available in a variety of line-power configurations, as shown in Table 6-1. When connected to the 8020B it effectively removes and replaces the output of the battery. The battery does not need to be removed from the circuit.

WARNING

DO NOT SUBSTITUTE A CALCULATOR TYPE BATTERY ELIMINATOR FOR THE A81. THESE UNITS DO NOT PROVIDE THE PROTECTION NECESSARY FOR COMMON MODE MEASUREMENTS UP TO 500V DC. ALWAYS USE THE MODEL A81 FOR AC-LINE OPERATION.

NOTE

The "BT" indicator may come on when using the A81. This does not affect the operation of the 8020B.

6-31. CURRENT SHUNT (80J-10)

6-32. Introduction

6-33. The Model 80J-10 Current Shunt extends the current measuring capability of the DMM to 10 amps continuous (20 amps for periods not exceeding one minute) dc to 10 kHz at an accuracy of ±0.25% in excess of the voltmeter accuracy.

Table 6-1. A81 Model vs Input Power

MODEL NO.	INPUT POWER
A81-100	100V ac ±10%, 48 to 62 Hz
A81-115	115V ac ±10%, 48 to 62 Hz
A81-230-1	230V ac ±10%, 48 to 62 Hz (U.S. type plug)
A81-230	230V ac ±10%, 48 to 62 Hz (European type plug)

6-34. Specifications

SHUNT	10 amps at 100 mV
ACCURACY (18°C to 28°C)	
DC to 10 kHz	±0.25%
10 kHz-100 kHz	Rising to 1 dB at 100 kHz typical
TEMPERATURE COEFFICIENT	0.005%/°C
INDUCTANCE	8.3 nH in series w/0.01Ω shunt
OVERLOAD	Up to one minute at 20A with a 1/4 duty cycle for recovery after currents between 10A and 20A
CONNECTS TO	3/4 inch center banana jacks
CONNECTORS	5-way binding posts (red and black)

6-35. AC/DC CURRENT PROBE (Y8100)

6-36. Introduction

6-37. The Fluke Y8100 AC/DC Current Probe is a clamp-on probe that is used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac on dc) current measurements. The jaws on the Y8100 are designed to clamp around conductors up to 3/4 inch in diameter. The pistol shape allows safe, easy, one-hand operation when making current measurements.

6-38. The Model Y8100 probe is battery powered with size AA cells. It measures current to 200A dc or ac rms using most any voltmeter. Two ranges,20A and 200A, produce a 2V output at full-range current.

6-39. Specifications

RANGES	20A ac or dc 200A ac or dc
RATED OUTPUT	2V at full range
ACCURACY	
DC to 200 Hz	±2% of range
200 Hz to 1 kHz	<100A add ±3% reading >100A add ±6% reading
CALIBRATION CYCLE	1 year
FREQUENCY RESPONSE	dc to 1.0 kHz
RECOMMENDED LOAD	≥3.0 kΩ
TEMPERATURE RANGE	+15°C to +35°C; for specified accuracy –10°C to +50°C; storage and operation at reduced accuracy.
HEATING LIMITATION	Prolonged operation above 200A ac or 1 kHz can cause damage to the Y8100.
WORKING VOLTAGE RATING	Core to output; 600V dc or 480V ac maximum output to ground; 42V dc or 30V ac
APERTURE SIZE	3/4″ (19 mm) diameter
SIZE-OVERALL	9″ x 4-1/2″ x 1-7/16″ (230 mm x 115 mm x 37 mm)
WEIGHT	14 ounces (0.4 kg), with batteries
POWER	Battery, four AA cells
BATTERY LIFE	Alkaline-20 hours continuous

6-40. AC CURRENT TRANSFORMER (Y8101)

6-41. Introduction

6-42. The Model Y8101 (Figure 6-1) is a small clamp-on current transformer designed to extend the current measuring capability of an ac current meter up to 150 amperes. A clamp-on coil designed into the probe allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1:1000 transformer. The current-carrying conductor being measured serves as the primary.

6-43. Specifications

CURRENT RANGE	2A to 150A
	±2%, 10A to 150A
ACCURACY, (48 Hz TO 10 kHz) .	±8%, 2A to 10A
DIVISION RATIO	1000:1
WORKING VOLTAGE	300V ac rms maximum
INSULATION DIELECTRIC	
WITHSTAND VOLTAGE	3 kV rms
MAXIMUM CONDUCTOR SIZE	7/16" (1.11 cm)

6-44. SAFETY DESIGNED TEST LEAD SET (Y8132)

6-45. This test lead set is equivalent to the set originally supplied with the 8020B multimeter. The set includes one red and one black test lead. Each probe has an anti-slip shoulder near the test tip and is connected to the multimeter via a safety-designed shrouded banana connector. This set will fit John Fluke instruments with safety-designed input jacks.

6-46. DELUXE TEST LEAD SET (Y8134)

6-47. The Y8134 is a deluxe test lead set. The attachments provided allow interconnection with a wide variety of leads and electronic components. Included in the kit are:

1. Two test leads (one red and one black). The Y8134 leads have a shrouded banana connectors on each end.
2. Two test probes
3. Two insulated alligator clips
4. Two spade lugs
5. One squeeze hook
6. One test lead pouch
7. One instruction sheet

6-48. SLIM FLEX TEST LEAD SET (Y8140)

6-49. The Y8140 Test Lead Set (Figure 6-1) consists of one red and one black 60-inch (1.52 meter) test lead, each with a standard banana plug on one end and an extendable tip probe on the other end. This flexible metallic tip conductor may be extended up to 2.5 inches and is insulated to within 0.1 inch of its tip. This insulation reduces the chance of creating an inadvertent short circuit while using the probes in their extended configuration. Intended primarily for measuring voltages, the Y8140 leads may also be used for measuring modest currents.

Section 7
Schematic Diagrams

TABLE OF CONTENTS

FIGURE	TITLE	PAGE
7-1.	8020B	7-2
7-2.	U1 and U3, A/D Converter and Display	7-6

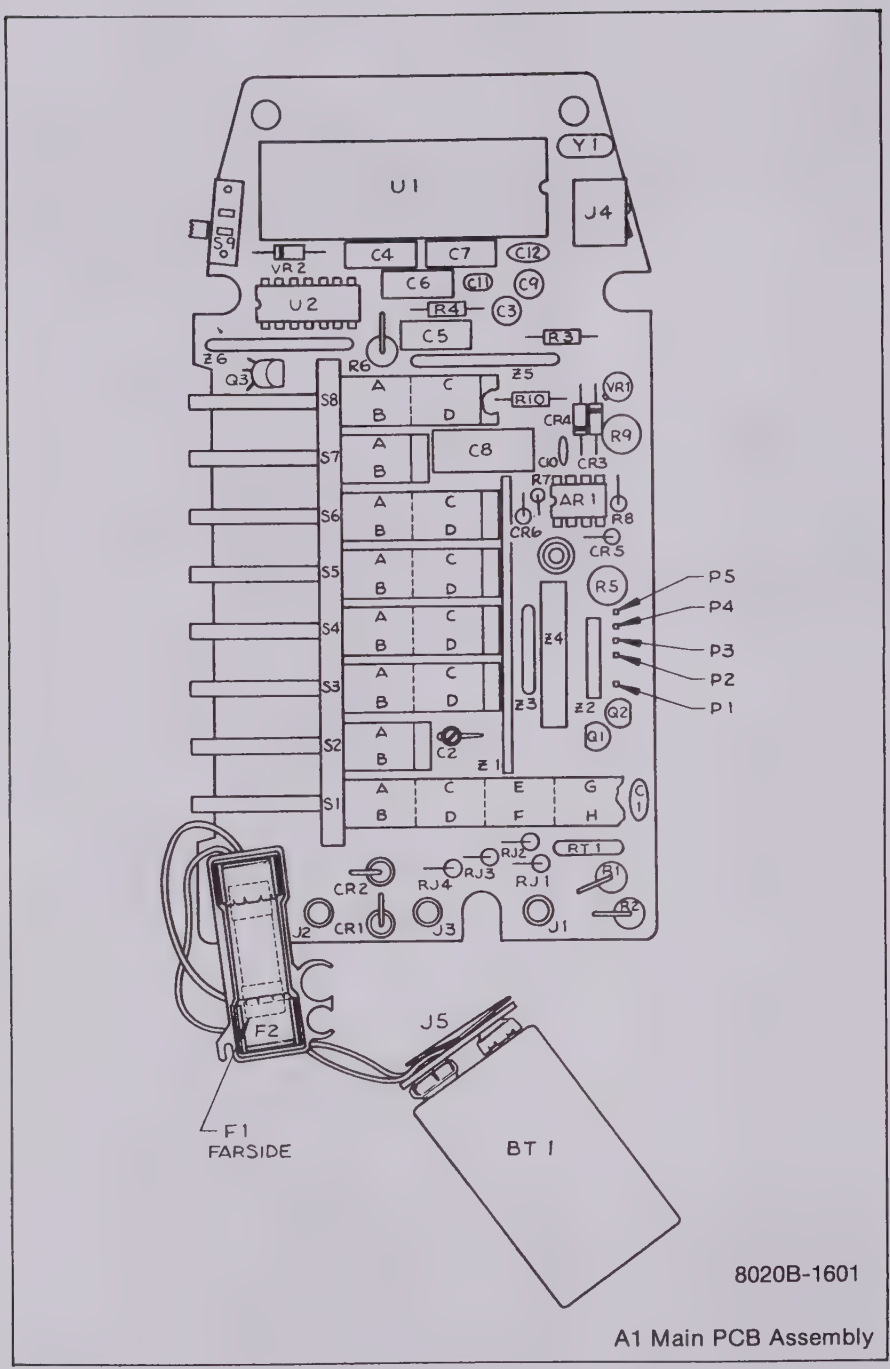


Figure 7-1. 8020B

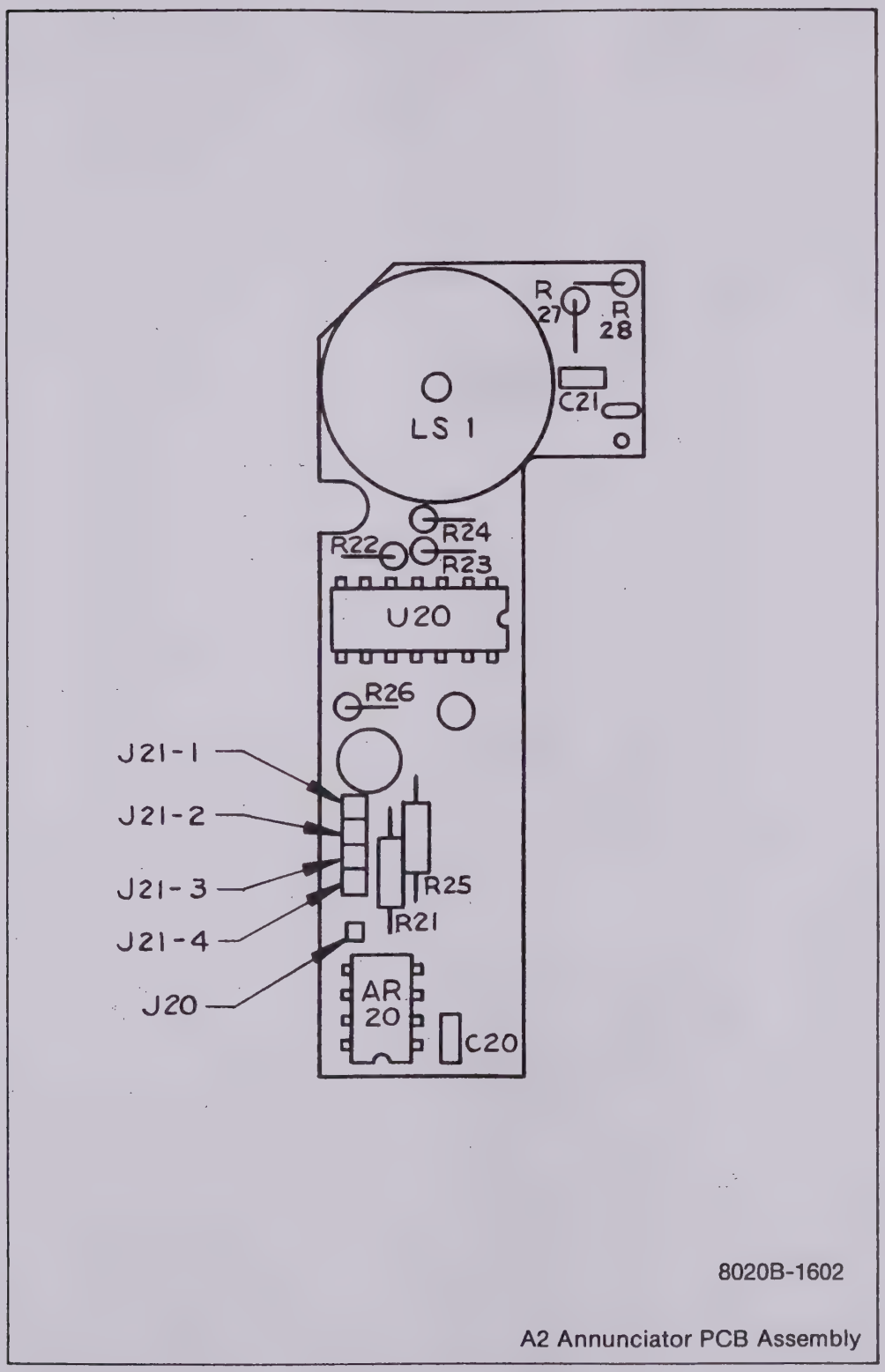


Figure 7-1. 8020B (cont)

8020B

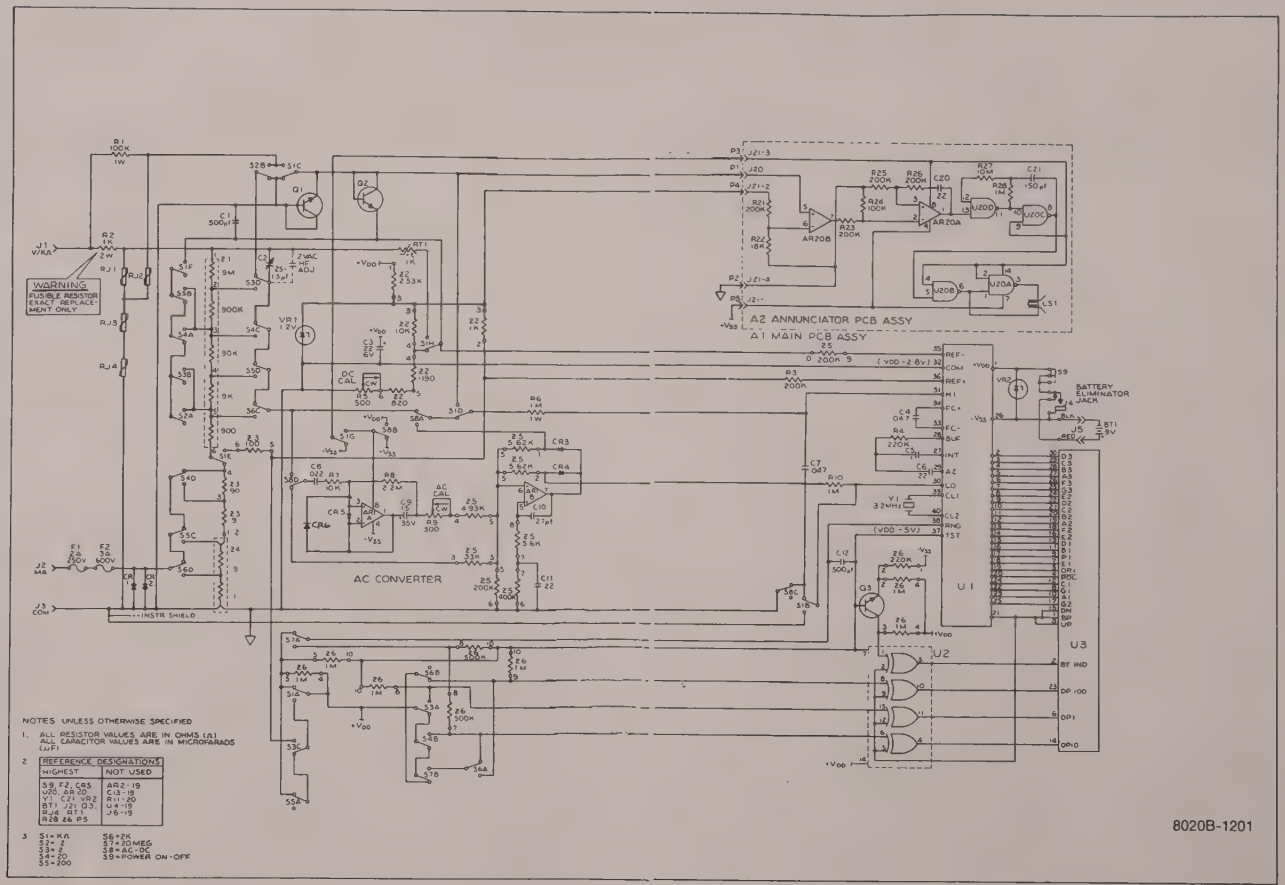


Figure 7-1. 8020B (cont)

8020B

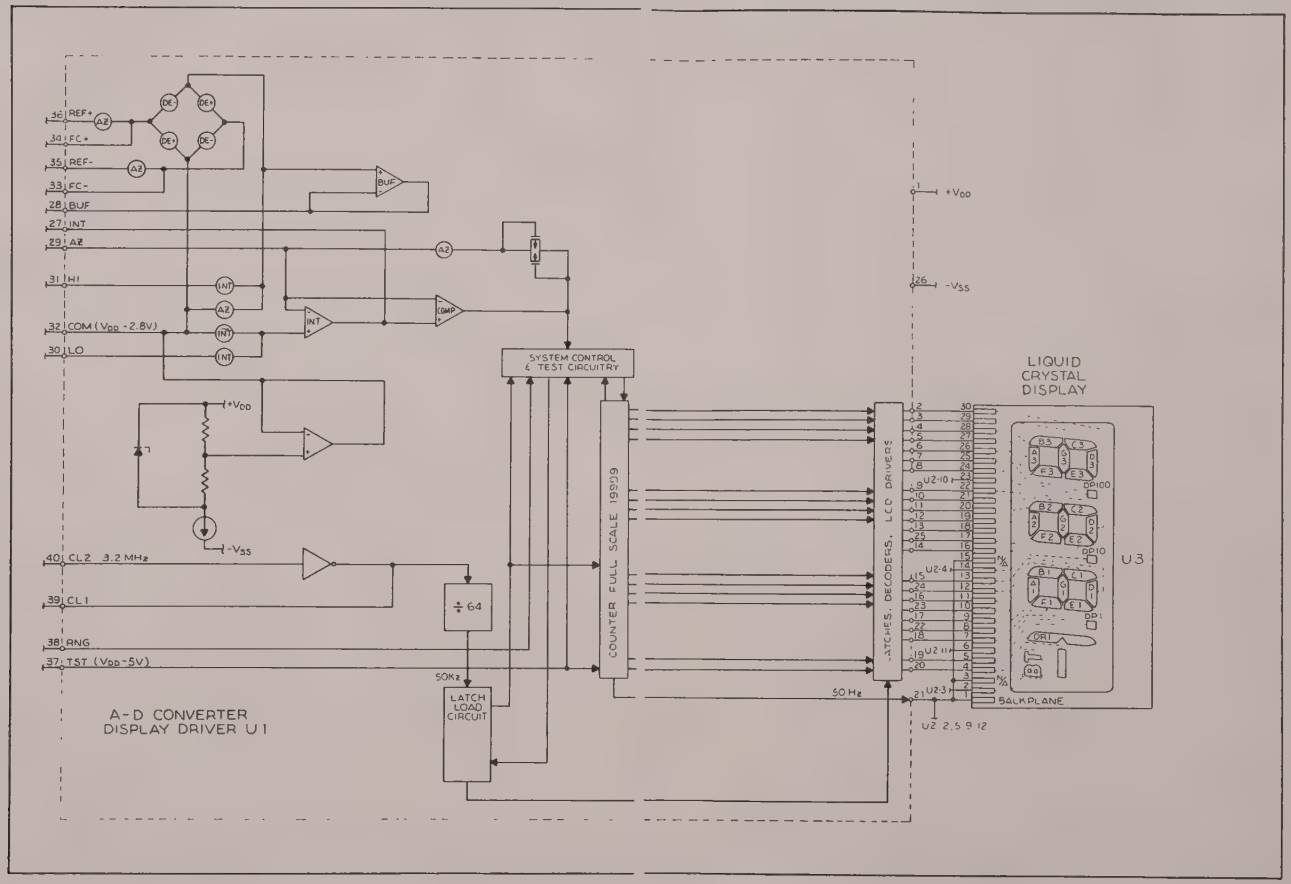


Figure 7-2. U1 and U3, A/D Converter and Display

Appendix A
Manual Change and Backdating Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configuations. To identify the configuration of the pcbs used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with an earlier assembly revision level, perform the changes indicated in Table A-1.

CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

Table A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			–	A	B	C	D	E	F	G	H	J	K	L	M	N	P									
A1	MAIN PCB ASSEMBLY	613919	●	X																					
A2	ANNUNCIATOR PCB ASSEMBLY	613943	●	X																					

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
– = No revision letter on the PCB.

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO. INC., warrants each instrument is manufactures to be free from defects in material and workmanship under normal use and service for the period of 2 years from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargable type batteries are warranted for 90 days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co. Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 2 years from date of purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 2 years of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be substituted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. INCLUDING BUT NOT LIMITTED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO. INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO. INC., or nearest Servicefacility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO. INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. and surrounded with at least four inches of excelsior or similiar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO. INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO. INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co. Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

U.S. SALES OFFICES for all Fluke products

AK, Anchorage
Harry Lang & Associates
1371 Hillcrest Drive #303
Anchorage, AK 99503
(907) 279-5741

AL, Huntsville
John Fluke Mfg. Co., Inc.
3322 Memorial Parkway
Huntsville, AL 35801
(205) 881-6220
(404) 396-3224 (Atlanta)

AZ, Tempe
John Fluke Mfg. Co., Inc.
2125 S. 48th Street
Suite 104
Tempe, AZ 85282
(602) 967-8724
(602) 790-9881 (Tucson)

CA, Los Angeles
John Fluke Mfg. Co., Inc.
20902 South Bonita St.
Carson, CA 90746
(213) 538-3900 or
(714) 761-2449

CA, Santa Clara
John Fluke Mfg. Co., Inc.
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95050
(408) 727-0513

CA, Tustin
John Fluke Mfg. Co., Inc.
15445 Red Hill Ave., Suite F
Tustin, CA 92680
(714) 838-8863
(714) 226-1254 (San Diego)

CO, Denver
John Fluke Mfg. Co., Inc.
1980 South Quebec St. #4
Denver, CO 80231
(303) 750-1222

CT, Hartford
John Fluke Mfg. Co., Inc.
124 Hebron Ave.
Glastonbury, CT 06033
(203) 633-0777

FL, Orlando
John Fluke Mfg. Co.,Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

HI, Honolulu
EMC Corporation
2979 Ualena St.
Honolulu, HI 96819
(808) 836-1138

IA, Iowa City
John Fluke Mfg. Co., Inc.
1027 Hollywood Blvd., #309
Iowa City, IA 52240
(319) 354-2811

IL, Chicago
John Fluke Mfg. Co., Inc.
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-0850

IN, Indianapolis
John Fluke Mfg. Co., Inc.
5610 Crawfordsville Rd.
Suite 802
Indianapolis, IN 46224
(317) 244-2456

KA, Kansas City
John Fluke Mfg. Co., Inc.
4550 West 109th St.
Suite 130
Shawnee Mission, KA 66211
(913) 381-9800

MA, Burlington
John Fluke Mfg. Co., Inc.
25 "B" Street
Burlington MASS
(617) 273-4674

MD, Rockville
John Fluke Mfg. Co., Inc.
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570
(301) 792-7060 (Baltimore)

MI, Detroit
John Fluke Mfg. Co., Inc.
13955 Farmington Rd.
Livonia, MI 48154
(313) 522-9140

MN, Minneapolis
John Fluke Mfg. Co., Inc.
7373 West 147th Street
Suite 196
Apple Valley, MN 55124
(612) 432-9400

MO, St. Louis
John Fluke Mfg. Co., Inc.
300 Brookes Dr., Suite 100
Hazelwood, MO 63042
(314) 731-3388

NC, Greensboro
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
John Fluke Mfg. Co., Inc.
P.O. Box 930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

NM, Albuquerque
John Fluke Mfg. Co., Inc.
1108 Alvarado Drive N.E.
Albuquerque, NM 87110
(505) 265-8431

NY, Rochester
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 266-1400

OH, Cleveland
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

OH, Dayton
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238

OR, Portland
John Fluke Mfg. Co., Inc.
18360 S.W. Springfield Lane
Aloha, OR 97007
(503) 642-1342

PA, Philadelphia
John Fluke Mfg. Co., Inc.
1010 West 8th Ave., Suite H
King of Prussia, PA 19406
(215) 265-4040
(412) 261-5171 (Pittsburgh)

TX, Austin
John Fluke Mfg. Co., Inc.
111 W. Anderson Lane
Suite 213
Austin, TX 78752
(512) 478-9901
(512) 340-2621 (San Antonio)

TX, Dallas
John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75234
(214) 233-9990

TX, Houston
John Fluke Mfg. Co., Inc.
1014 Wirt Road, Suite 270
Houston, TX 77055
(713) 683-7913

UT, Salt Lake City
John Fluke Mfg. Co., Inc.
782 East 8325 Street
Sandy, UT 84070
(801) 566-4864

WA, Seattle
John Fluke Mfg. Co., Inc.
975 Industry Drive
Seattle, WA 98188
(206) 575-3765

For more information on Fluke products or Sales Offices you may dial (800) 426-0361 toll-free in most of U.S. From Alaska, Hawaii, or Washington, phone (206) 774-2481. From other countries phone (206) 774-2398.

INTERNATIONAL SALES OFFICES

Argentina ●
Coasin, S.A.
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 525130, TLX: 390122284

Australia ●
Elmeasco Instruments Pty Ltd.
P.O. Box 30, Concord, N.S.W.
Australia 2137
Tel: (2) 736-2888, TLX: 79025887

Elmeasco Instruments Pty Ltd.
P.O. Box 107
Mt. Waverly, VIC. 3149
Australia
Tel: 233-4044
TLX: 36206 (ELMVIC)

Elmeasco Instruments Pty Ltd.
Professional Suite's Bldg.
B.P.O. Box 2360
Brisbane, 4001, Australia
Tel: (07) 229-3161

Elmeasco Instruments Pty Ltd.
P.O. Box 1240
G.P.O. Adelaide 5001
South Australia

Elmeasco Instruments Pty. Ltd.
P.O.Box 95, Gosnells
West Australia 6110
Tel: (09) 348-3362

Austria ■
Walter Rekirsch
Elektronische Gerate GmbH & Co
Vertriebs-KG., Obachgasse 28
A-1220 Vienna, Austria
Tel: (0222) 23555 TLX: 134759

Belgium ■
Fluke (Belgium) S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: (2) 2164090, TLX: 26312

Bolivia ●
Coasin Bolivia S.R.L.
Casilla 7295, La Paz, Bolivia
Tel: 40962

Brazil ●
Arotec S.A.
Industria e Comercio
Av. Pacaembu 811
01234 Sao Paulo S.P., Brazil
Tel:(011) 826-2266, TLX: 1122207

Arotec S.A.
Rua Araguari, 1705 s/402
30.000 Belo Horizonte M.G., Brazil

Tel: 335-7735

Arotec S.A.
Av. Rio Branco, 277, Grupo 1309
02000 Rio de Janeiro, R.J., Brazil
Tel: (021) 242-9776

Brunei ●
Rank O'Connor's (PTE) Limited
No. 8, BK D
Surfri Shop House Complex
Mile 1, Jalong Tutong
Bandar Seri Begawan, Brunei
Tel: 26680

Bulgaria ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Canada ●
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E.
Calgary, Alberta T2E 6Z5
Tel: (403) 230-1341

Allan Crawford Assoc., Ltd.
3795 William Street
Burnaby, British Columbia V5C 3H3
Tel: (604) 294-1326

Allan Crawford Assoc., Ltd.
192 Joseph Zatzman Dr.
Suite 4
Burnside Industrial Park
Dartmouth, Nova Scotia B3B 1N4
Tel: (902) 463-9360

Allan Crawford Assoc., Ltd.
881 Lady Ellen Place
Ottawa, Ontario K1Z 5L3
Tel: (613) 722-7682

Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario L4V 1J5
Tel: (416) 678-1500

Allan Crawford Assoc., Ltd.
7018 cote de Liesse
St. Laurent, Quebec H4T 1E7
Tel: (514) 731-8564

Chad ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

Chile ●
Intronica Chile Ltda.
Manuel Montt 024 - Of. D
Casilla 16228, Santiago 9, Chile
Tel: 44940
TLX: No 40301 Cab. Publ.,
Attn: Intronica Chile

China, People's Republic of ●
Fluke International Corporation
P.O. Box 43210
Mountlake Terrace, WA 98043
Tel: (206) 774-2398
TLX: 152662 JOHNFLUKE MTLT

Colombia ●
Coasin Ltda.
Carrera 13, No. 37-37, Of. 401
Ap. Aero 29583
Bogota DE, Colombia
Tel: 232-45-32, TLX: 45787

Cyprus ■
Chris Radiovision Ltd.
P.O. Box 1989, Nicosia, Cyprus
Tel: 66121, TLX: 2395

Czechoslovakia ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Denmark ■
Tage Olsen A/S
Ballerup Byvej 222
DK - 2750 Ballerup, Denmark
Tel: (2) 658111, TLX: 35293

Ecuador ●
Proteco Coasin Cia., Ltda.
Edificio "Jerico"
Ave. 12 de Octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 529684, TLX: 2865 Protec Ed

Proteco Coasin Cia., Ltda.
Calderon 103Y Malecon
Casilla #9733
Guayaquil, Ecuador
Tel: 526093

Egypt and Sudan ■
Lotus Engineering Organisation
P.O. Box 1252
22, Kafr El Nil
Cairo, Egypt
Tel: 971617, TLX: 92504

Eire (Republic of Ireland) ■
EURO Electronics
32 Brews Hill
Naven, County Meath, Ireland
Tel: 46-23577, TLX: 3182

Ethiopia ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

Finland ■
Oy Findip AB, Teollisuustie 7
02700 Kauniainen, Finland
Puh: (0) 5052255
TLX: 123129

France ■
M.B. Electronique S.A.
Rue Fourny 606, Z1 Centre
78530 BUC
B.P. No. 31
78530 BUC, France
Tel: (3) 9568131, TLX: 695414

German Democratic Republic ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

German Federal Republic ■
Fluke (Deutschland) GmbH
Max-Hueber StraBe 8
8045 Ismaning, West Germany
Tel: (089) 96251, TLX: 522472
Rapifax: (089) 966718

Fluke (Deutschland) GmbH
MeineckestraBe 53
4000 Dusseldorf 30, West Germany
Tel: (0211) 450831, TLX: 8585576

Fluke (Deutschland) GmbH
Oberer Kirchhaldenweg 135
7000 Stuttgart 1, West Germany
Tel: (0711) 694091, TLX: 722518

Fluke (Deutschland) GmbH
Hubertusallee 46
1000 Berlin-33, West Germany
Tel: (030) 8911090
TLX: 0184978

Greece ■
Hellenic Scientific Representations Ltd.
11, Vrassida Street
Athens 615, Greece
Tel: (1) 711140, TLX: 219330

Hong Kong ●
Schmidt & Co. (H.K.) Ltd.
28th Fl, Wing on Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644
TLX: 74766 SCHMC HX

Hungary ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Iceland ●
Kristjan O. Skagfjord Ltd.
P.O. Box 906
Reykjavik, Iceland
Tel: 24120, TLX: 2133

India ●
Hinditron Services Pvt. Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 811316,
TLX: 953-112326 Hspl In

Hinditron Services Pvt. Ltd.
33/44-A 8th Main Road
Raj Mahl Vilas Extension
Bangalore 560 080, India
Tel: 33139
TLX: 0845741

Hinditron Services Pvt. Ltd.
Shantiniketan, Office No.6
6th Floor, 8 Camac Street
Calcutta 700 017, India
Tel: 434032, 447541

Hinditron Services Pvt. Ltd.
15 Community Centre, Panchshila Park
New Delhi 110 017, India
Tel: 619118

Hinditron Services Pvt. Ltd.
Srinath Complex, 5th Floor
1-1-58/1 to 1-1-58/11
Sarojini Devi Road
Secunderabad 500 003, India
Tel: 61705

Indonesia ●
P.T. Dwi Tunggal Jaya Sakti
Sangga Buana Bldg., 1st Floor
Jl. Senen Raya 44, P.O. Box 4435
Jakarta, Indonesia
Tel: 367390-9, TLX: 46624

Iran ■
Irantronics Company Ltd.
20, Salm Road
Roosevelt Avenue, Tehran, Iran
Tel: 828294/831564
TLX: 212956

Iraq ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

Ireland ■
Euro Electronics
32 Brews Hill
Naven County Meath, Ireland
Tel: (46) 23577, TLX: 3182

Israel ■
R.D.T. Electronics Engineering Ltd.
P.O. Box 75
46, Sokolov Street
Ramat Hasharon 47235, Israel
Tel: (3) 483212, TLX: 32143

Italy ■
Sistrel S.p.A.
Via Giuseppe Armellini No. 37
00143 Rome, Italy
Tel: (6) 5915551, TLX: 68356

Sistrel S.p.A.
Via Pelizza da Volpedo 59
20092 Cinisello besamo
Milan, Italy
Tel: (2) 6181893, TLX: 334643

Sistrel S.p.A.
Via Cintia Parco S. Paolo 35
80126 Naples, Italy
Tel: (81) 7679700

Japan ●
John Fluke Mfg. Co., Inc.
Japan Branch
(PC Board Testers only)
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5425
TLX: 3823-666 FLKJPJ

Tokyo Electron Ltd.
38 FL Shinjuko Nomura Bldg.
1-26-2, Nishi-Shinjuku
Shinjuku-ku
Tokyo 160, Japan
Tel: 03-343-4411, TLX: 2322220

Kenya ●
ADCOM Ltd.
P.O. Box 30070
Nairobi, Kenya, East Africa
Tel: 331955, TLX: 22639

Korea ●
Electro-Science Korea Co.
C.P.O. Box 8446
Rm. 501, Boondo Bldg.
56-12 Jangchung-IKa
Jung-ku
Seoul, Korea
Tel: 261-7702, TLX: K25381

Kuwait ■
Tareq Company
P.O. Box Safat 20506
Kuwait, Arabian Gulf
Tel: 436100/436045
TLX: 2315

Lebanon and Jordan ■
Mabek (Electronics Division)
P.O. Box 11-3823
Beirut, Lebanon
Tel: 252631/348728
TLX: 22889

Libya ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

Malaysia ●
Rank O'Connor's (PTE) Limited
P.O. Box 91, Petaling Jaya
Selangor, West Malaysia
Tel: 566599
TLX: OCONOR MA37649

Rank O'Connor's (PTE) Limited
Lot No. 5 Taman Mesra
Mile 3, Jalan Penampang
Kota Kinabulu, East Malaysia
Tel: 55322, TLX: MA80286

Mexico ●
Christensen S.A. De C.V.
Instrumentos Electronicos de Medicion
Melchor Ocampo 150-8
Mexico 4 D.F., Mexico
Tel: (905) 535-2258
TLX: 1775612

Morocco ■
Mainvest
Residence Moulay Ismail, Bat. C.
12, Place des Alaouites
Rabat, Morocco
Tel: (7) 23990, TLX: 31036

Netherlands ■
Fluke (Nederland) B.V.
Zonneban 39
3606 CH Maarssen
P.O. Box 225
3600 AE Maarssen
Tel: (030) 436514, TLX: 47128

New Zealand ●
W & K McLean Ltd.
P.O. Box 18065, Glen Innes
Auckland, New Zealand
Tel: 587-037
TLX: N.Z. 7912763

W & K McLean Ltd.
P.O. Box 2421
Christchurch, New Zealand
Tel: 851-450

W & K McLean Ltd.
P.O. Box 496
Wellington, New Zealand
Tel: 851-450

Nigeria ●
Mofat Engineering Co., Ltd.
P.O. Box 6369
Lagos, Nigeria
TLX: 21353, Attn: MOFAT

Norway ■
Morgenstierne & Co A/S
Konghellegate 3/5
P.O. Box 6688, Rodeiokka
Oslo 5, Norway
Tel: (2) 356110, TLX: 11719

Pakistan ●
Pak International Operations
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323, Karachi, Pakistan
Tel: 221127, TLX: 24494

PDR Yemen ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

Peru ●
Importaciones Y Representaciones Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650, TLX: 37425663

Phillipines ●
Spark Radio & Electric Supply
P.O. Box 610, Greenhills, San Juan
M. Manila, Phillipines
Tel: 78-78-16
TLX: 27901 RLA PH

Poland ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Portugal ■
Decada-Equipamentos de Electronica, Lda.
P.O. Box 1128, 1003
Lisbon Codex, Portugal
Tel: (1) 574984, TLX: 18469

Qatar ■
Technology Organisation
P.O. Box 5549, Doha, Qatar
Tel: 321431, TLX: 4581

Romania ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Saudi Arabia ■
Electronic Equipment Marketing Co. Ltd.
P.O. Box 3750
Riyadh, Saudi Arabia
Tel: 4032761, TLX: 201120

Singapore ●
Rank O'Connor's (PTE) Limited
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944
TLX: OCONSIN RS21023

Somalia ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

South Africa ●
Fluke S.A. (Pty) Ltd.
P.O. Box 39797, Bramley 2018
Republic of South Africa
Tel: (011) 786-3170, TLX: 424328

Spain ■
Hispano Electronca S.A.
Piligono Industrial Urtinsa
Apartado de Correos 48
Alcorcon (Madrid), Spain
Tel: (1) 6194108
TLX: 22404/42634

Sweden ■
Teleinstrument AB
P.O. Box 4490
162 04 Vallingby, Sweden
Tel: (8) 380370, TLX: 11347

Switzerland ■
Traco Electronic Company Ltd.
Jenatschstrasse 1
8002 Zurich, Switzerland
Tel: (1) 2010711, TLX: 54318

Syria ■
Mabek (Electronics Division)
P.O. Box 4238
Damascus, Syria

Taiwan ●
CCT Associates, Inc.
P.O. Box 32-79
Taipei, Taiwan, Republic of China
Tel: (02) 391-6894,
TLX: 24263 Longgulf

Thailand ●
Dynamic Supply Engineering R.O.P.
12 SOI, Pasana 1, Ekami Sukhumvit 63
Bangkok-11, Thailand
Tel: 3925313
TLX: TH 82938 MONTIEN TH

Tunesia ■
Selep S.A.R.L
6, Rue de Sparte
Tunis - 1000 RP, Tunesia
Tel. (1) 248093, TLX: 13030

Turkey ■
Erkman Elektronik Aletler Ticaret Anonim Sirketi
Necatiby Cad 92/3
Karakoy, Istanbul, Turkey
Tel. (1) 5461
TLX: 23353

United Arab Emirates & Oman ■
Haris A1-Afag Ltd.
P.O. Box 545
Sharajah, United Arab Emirates
Tel: 35912/359121/359122/359123
TLX: 23966

United Kingdom ■
Fluke (G B) Ltd.
Colonial Way
Watford, Herts, WD2 4TT
United Kingdom
Tel: (0923) 40511, TLX: 934583
Rapifax: (0923) 25067

Uruguay ●
Coasin Uruguaya S.R.L.
Cuareim 2196
Casilla de Correos 1400
Correo Central
Montevideo, Uruguay
Tel: 29-31-95, TLX: 37425663

U.S.S.R. ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Venezuela ●
Coasin, C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Piso 3, La Urbina
Apartado De Correos NR-70.136 Los Ruices
Caracus 1070A, Venezuela
Tel: 38-78-42, TLX: 2102

Yemen ■
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel. (013) 673973, TLX: 52237

Yugoslavia ■
Amtest Associates Ltd.
P.O. Box 55
Addlestone, Surrey KT 15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

■ Supplied and Supported by —
Fluke (Holland) B.V.
P.O. Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

● Supplied and Supported by —
Fluke International Corporation
P.O. Box C9090
Everett, WA 98206
Tel: (206) 356-6300
TLX: 152662 JOHNFLUKE MTLT

● Latin America also supported by —
Sr. Benewaldo Padovani
c/o AROTEC S.A.
Industria e Comercio
Av. Pacaembu 811
01234 Sao Paulo S.P., Brazil
Tel: (011) 826-2266
TLX: 1122207 AROT BR

TECHNICAL SERVICE CENTERS

U.S. & Canada

CA, Burbank
Fluke Technical Center
2020 N. Lincoln Street
Burbank, CA 91504
(213) 849-4641

CA, Santa Clara
Fluke Technical Center
1980 S. Quebec St., Unit 4
Denver, CO 80231
(303) 750-1228

FL, Orlando
Fluke Technical Center
940 N. Fern Creek Avenue
Orlando, FL 32803
(305) 896-2296

IL, Rolling Meadows
Fluke Technical Center
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-5800

MA, Burlington
Fluke Technical Center
25 "B" Street
Burlington, MA 01803
(617) 273-4678

MD, Rockville
Fluke Technical Center
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1576

MN, Apple Valley
Fluke Technical Center
Suite 196
7373 West 147th Street
Apple Valley, MN 55124
(612) 432-7050

NC, Greensboro
Fluke Technical Center
1310 Beaman Place
Greenboro, NC 27408
(919) 273-1918

NJ, Paramus
Fluke Technical Center
West 75th Century Road
Paramus, NJ 07652
(201) 262-9550

TX, Dallas
Fluke Technical Center
14400 Midway Road
Dallas, TX 75240
(214) 233-9945

WA, Everett
Fluke Technical Center
P.O. Box C9090 M/S 17A
Everett, WA 98206
(206) 356-5560

ALB, Calgary
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E.
Calgary, Alberta T2E 6Z5
(403) 230-1341

ONT, Mississauga
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario 1 4V 1J2
(416) 678-1500

QUE, Montreal
All Crawford Assoc., Ltd.
7918 Cote de Liesse
Montreal, Quebec H4I 1E7
(514) 731-8564

B.C., Burnaby
All Crawford Assoc. Ltd.
795 William St.
Burnaby, B.C. V5C 3H3
(604) 294-1326

Other Areas

Argentina
Fluke Latin American
Service Headquarters
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 523185

Australia
Elmeasco Instruments Pty Ltd
P.O. Box 30
Concord, N.S.W.
Australia 2137
Tel: (02) 736-2888

Australia
Elmeasco Instruments Pty. Ltd.
P.O. Box 107
Mr. Waverly, VIC 3149
Australia
Tel: (03) 2334044

Australia
Elmeasco Instruments Pty. Ltd.
GPO Box 2360
Brisbane, Queensland 4001
Australia
Tel: (07) 229-3161

Austria
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertriebs-KG
LiechtensteinstraBe 97/6
A-1090 Vienna, Austria
Tel: 09-43-222-347646

Belgium
Fluke (Belgium) S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: 09-32-2-2164090

Brazil
Arotec S.A.
Industria e Comercio
Av. Pacaembu 811
01234 Sao Paulo S.P., Brazil
Tel: 826-2266

Chile
Intronica Chile Ltda.
Casilla 16228
Santiago 9, Chile
Tel: 44940

Colombia
Coasin Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aero 29583
Bogota D.E., Colombia
Tel: 285-0230

Denmark
Tage Olson A/S
Ballerup Byvej 222
DK-2750 Ballerup
Denmark
Tel: (01)2-65 81 11

Ecuador
Proteco Coasin Cia., Ltda.
Edificio "Jerico"
Ave. 12 de Octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 526759

Egypt
Lotus Engineering Organisation
P.O. Box 1252
Cairo, Egypt
Tel. 971617

Finland
Oy Findip AB
Teollisuustie 7
02700 Kauniainen
Finland
Tel: 09-358-0-502255

France
M.B. Electronique S.A.
Rue Fourny
ZAC de BUC
B.P. No. 31
78530 BUC, France
Tel: 09-33-1-9568131

Greece
Hellenic Scientific
Representations Ltd.
11, Vrassida Street
Athens 615, Greece
Tel: 09-30-1-711140

Hong Kong
Schmidt & Co. (H.K.) Ltd.
28th Fl. Wing On Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644

India
Hinditron Services Pvt. Ltd.
Field Service Centre
33/44-A, 8th Main Road
Rajmahal Vilas Extn.
Bangalore 560 080, India

India
Hinditron Services Pvt. Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 365344

India
Hinditron Services Pvt. Ltd.
15, Community Centre
Panchashila Park
Delhi 110 010, India

Israel
R.D.T. Electronics Engineering Ltd.
P.O. Box 75
46, Sokolov Street
Ramat Hasharon 47235
Israel
Tel: 09-972-3-483211

Italy
Sistrel S.p.A.
Via Pelizza da Volpedo 59
20092 Cinisello Besamo
Milan, Italy
Tel. (2) 6181893

Italy
Sistrel S.p.A.
Via Guiseppe Armellini No. 37
00143 Rome, Italy
Tel: 09-39-6-5915551

Japan
John Fluke Mfg. Co., Inc.
Japan Branch
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5428

Korea
Electro-Science Korea Co.
C.P.O. Box 8446
Rm. 707 Bowon Bldg.
490 Chongro - 5 Ka
Chongro-ku
Seoul, Korea
Tel: 261-7702

Malasia
Rank O'Connor's (Malasia) SDN. BHD.
P.O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel: 566599

Mexico
C.J. Christensen S.A. De C.V.
Melchor Ocampo 150-8
Mexico 4 D.F., Mexico
Tel: (905) 535-2258

Netherlands
Fluke (Nederland) B.V.
P.O. Box 5053
5004 EB Tilburg
The Netherlands
Tel: 684971

New Zealand
W & K McLean Ltd.
P.O. Box 18065
Glen Innes
Auckland, New Zealand
Tel: 587-037

Norway
Morgenstierne & Co. A/A
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 09-47-2-356110

Pakistan
Pak International Operations
505 Mohammadi House
I.I. Chundrigar Road
Karachi-2 Pakistan
Tel: 221127/239052

Peru
Importaciones Y Representaciones
Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650

Peru
Spark Radio and Electric Supply
P.O. Box 610
Greenhills, San Juan
Metro Manila, Philippines
Tel: 78-78-16

Portugal
Equipamentos de Laboratorio, Ltda.
P.O. Box 1100
Lisbon 1002, Portugal
Tel: 09-351-1-578936/547512

Republic of Singapore
Rank O'Connor's (PTE) Ltd.
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944

Republic of South Africa
Fluke S.A. (Pty) Ltd.
P.O. Box 39797
Bramley 2018
Republic of South Africa
Tel: (011) 786-3170

Spain
Hispano Electronica S.A.
Apartado de Correos 48
Alcorcon (Madrid)
Spain
Tel: 09-341694108

Sweden
Teleinstrument AB
P.O. Box 490
S-162 Vallingby 4
Sweden
Tel. -09-46-8-380370

Switzerland
Traco Electronic AG
Jenalschstrasse 1
8002 Zurich
Switzerland
Tel. 09-41-1-2010711

Taiwan
CCT Associates, Inc.
P.O. Box 32-79
Taipei, Taiwan
Republic of China
Tel: (02) 391-6894, 393-5760

Thailand
Dynamic Supply Engineering R.O.P.
12 Soi Pasana 1, Ekami
Sukhumvit 63
Bangkok 11, Thailand
Tel: 3925313

Turkey
Erkman Elektronik Atelier
Ticaret Anonim Sirketi
Necatiby Cad 92/3
Karakoy, Istanbul, Turkey
Tel: 09-44-1-5461

United Kingdom
Fluke (GB) Ltd.
Colonial Way
Watford, Herts, WD2 4TT
United Kingdom
Tel: 09-4492340511

Uruguay
Coasin Uruguaya S.R.L.
Cassilla de Correos 1400
Correo Central
Montevideo, Uruguay
Tel: 29-31-95

Venezuela
Coasin C.A.
Calle 9 Con Calle 4
Edif. Edinurbi
Piso 3, La Urbina
Apartado de Correos Nr-70 136
Los Ruices
Caracas 1070-A, Venezuela
Tel: 387842

West Germany
Fluke (Deutschland) GmbH
Krausstrabe 32
8045 Ismaning
West Germany
Tel: (089) 96251